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NAVAL STORES

History, Production, Distribution and Consumption

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HISTORY, PRODUCTION, DISTRIBUTION AND CONSUMPTION

COMPILED BY
THOMAS GAMBLE, EDITOR
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IN THE HEART OF THE VIRGIN LONG LEAF PINE FOREST, SOURCE OF NAVAL STORES WEALTH

PREFACE

THE work of preparing and publishing this book on naval stores has been made a pleasure by the unselfish and unstinted co-operation of many who are interested in the great industry and trade to which it is devoted.

No one has been approached for assistance who has failed to give it. There has been an interest shown in its preparation that has been extremely gratifying. The general feeling has been that there is a real need for a book of this character, the first ever undertaken along such lines.

While it has been impossible to publish all of the matter gathered from various sources, efforts have been made to draw together in one volume all that is vital. It is believed the various articles will be found of general interest and value. With three or four exceptions they were all especially written for this book.

I thank all who have helped me in the literary work as well as the many whose advertising favors have made possible the publication of the book at a time when expenses of printing are so enormously swollen.

The series of articles covering the wood distillation industry will be found of especial value. No one doubts that in coming years that industry will play an ever increasing part in supplying the demand for turpentine and rosins as well as the other products of such plants. The standardizing of such products and the greater capital, business capacity and technical skill called into play in the industry as a whole are placing it on a basis of assured permanency and bringing ready recognition of the value of its output throughout the world.

THOMAS GAMBLE.

Savannah, Ga., May 1, 1921.

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ADVERTISEMENTS

CORRECTIONS: In advertisement of Consolidated Naval Stores Co., on page 24, branches should read: Savannah Ga., Pensacola, Fla. In advertisement of Western Rosin & Turpentine Co., on page 96, the address should be No. 6512 East Palmer avenue, Detroit, Mich.

ILLUSTRATIONS

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LONG LEAF PINE. (PINUS AUSTRALIS.) FIG. 1. A LEAF: FIG. 2. A BUD: FIG. 3. A SEED

PINE TREES OF THE SOUTH AND THEIR PRODUCTS

AS DESCRIBED BY A FRENCH SCIENTIST OVER A CENTURY AGO.

(By Francois Andre Michaux.)

[Francois Andre Michaux was a prominent French botanist, born in 1770, died 1855. His father, Andre Michaux, was one of the most celebrated botanists and scientific travelers of his day. He came to America in 1785 on a scientific mission from the French government and made an extensive collection which was largely lost on his return trip, the French Revolution having forced his return home. His son, Francois Andre, accompanied him in his travels through the forests of America, and in 1802 and 1806 was sent to North America by the French Government. He wrote a history of the trees therein, published in 1810-13 in French, subsequently translated into English under the title, "The North American Sylva." The following are extracts and full page illustrations from the 1819 American edition.]

THE Long-Leaved Pine, or Pinus Australis, is known both in the continent which produces it, and in those to which it is exported, by different names. In the first it is called long-leaved pine, yellow pine, pitch pine and broom pine; in the Northern States it is called Southern pine and red pine, and in England and the West Indies Georgia pitch pine. I have preferred the first designation because this species has longer leaves than any other eastward of the Mississippi, and because the names yellow pine and pitch pine, which are more commonly employed, seem in the Middle States to designate two species entirely distinct and extensively diffused. The specific epithet Australis is more appropriate than that of Palustris, which has hitherto been applied to it by botanists, but which suggests an erroneous idea of the situation in which it grows.

Toward the North the long-leaved pine first makes its appearance near Norfolk, in Virginia, where the pine barrens begin. It seems to be especially assigned to dry, sandy soils and it is found almost without exception in the lower part of the Carolinas, Georgia and the Floridas, over a tract more than six hundred miles long, from northeast to southwest, and more than one hundred miles broad, from the sea toward the mountains of the Carolinas and Georgia. I have ascertained three points, about one hundred miles apart, where it does not grow, the first, eight miles from the River Nuse, in North Carolina, on the road from Louisburg to Raleigh; the second, between Chester and Winesborough in South Carolina; the third, twelve miles north of Augusta, in Georgia. Where it begins to show itself toward the River Nuse it is united with the loblolly pine, the yellow pine, the pond pine, the blackjack oak and the scrub oak, but immediately beyond Raleigh it holds almost exclusive possession of the soil and is seen in company with the pines just mentioned only on the edges of the swamps, enclosed in the barrens. Even there not more than one stock in a hundred is of another species. With this exception the long-leaved pine forms the unbroken mass of woods which cover the extensive country. But between Fayetteville and Wilmington, in North Carolina, the scrub oak is found in some districts associated in the barrens, and, except this species of pine, it is the only tree capable of sustaining in so dry and sterile a soil.

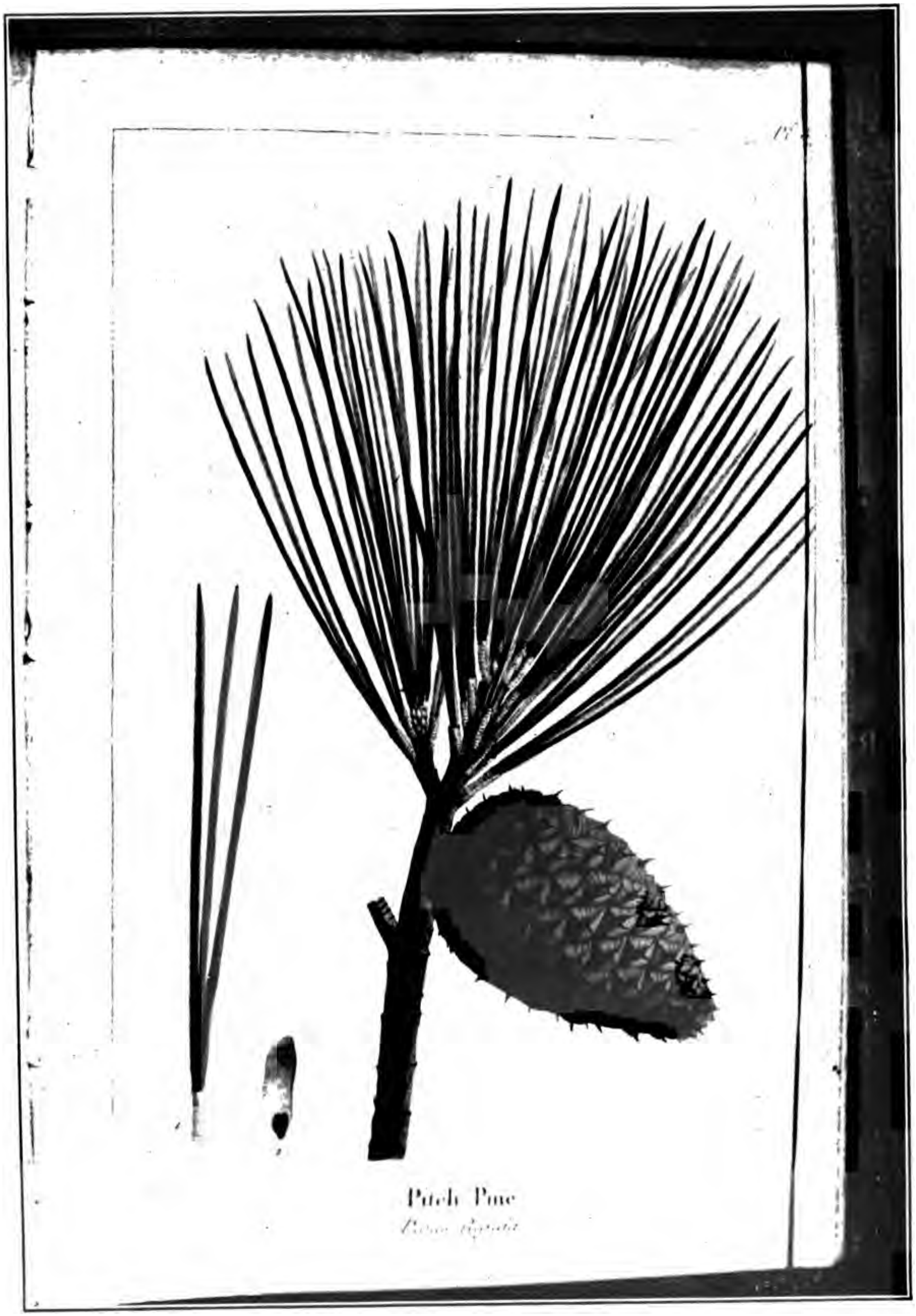
The mean stature of the long-leaved pine is sixty or seventy feet, with a uniform diameter of fifteen or eighteen inches for two-thirds of its height. Some stocks, favored by local circumstances, attain much larger dimensions, particularly in East Florida. The bark is somewhat furrowed, and the epidermis detaches itself in thin, transparent sheets. The leaves are about a foot long, of a beautiful, brilliant green, united to the number of three in the same sheath, and collected in bunches at the extremity of the branches. They are longer and more numerous on the young stocks, which are sometimes cut by the negroes for brooms. The buds are very large, white, fringed, and not resinous.

The bloom takes place in April. The male flowers form masses of divergent violet-colored aments about two inches long; in drying they shed great quantities of yellow pollen, which is diffused by the wind and forms a momentary covering on the surface of the land and water. The cones are very large, being seven or eight inches long, four inches thick, when open, and are armed with small retorted spines. In the fruitful year they are ripe about the fifteenth of October, and shed the seed the same month. The kernel is of an agreable taste and is contained in a thin, white shell, surmounted by a membrane. In every other specie of American pine the shell is black. Sometimes the seeds are very abundant and are voraciously eaten by wild turkeys, squirrels and the swine that live almost wholly in the woods. But in the unfruitful year a forest of a hundred miles in extent may be ransacked without finding a single cone. This probably occasioned the mistake of the French who in 1567 attempted a settlement in Florida and wrote that "The woods were filled with superb pines that never yielded seed." (See footnote.)

The long-leafed pine contains but little sap. Several trunks fifteen inches in diameter at the height of three feet, which I have myself measured, had ten inches of perfect wood. Many stocks of this size are felled for commerce and none are received for exportation of which the heart is not ten inches in diameter when squared. The concentrical circles in a trunk fully developed are close and at equal distance, and the resinous matter, which is abundant, is more uniformly distributed than in any other species. Hence the wood is stronger, more compact, and more durable; it is, besides, fine grained and susceptible of a bright polish. These advantages give it a preference over every other pine, but its quality is modified by the nature of the soil in which it grows. In the neighborhood of the sea, where only a thin layer of mould reposes on the sand, it is more resinous than where the mould is five or six inches thick. The stocks that grow upon the first mentioned soil are called pitch pine and the other yellow pine, as if they were different species.

This wood subserves a great variety of uses in the Carolinas, Georgia and Florida. Four-fifths of the houses are built of it, except the roof, which is covered with shingles of cypress, but in the country the roof is also of pine, and is renewed after fifteen or eighteen years, a considerable interval in a climate so warm and humid. A vast consumption takes place for the enclosure of cultivated fields. In naval architecture this is the most esteemed of pines. In the Southern States the keel, the beam, the sideplanks and the pins by which they are attached to the ribs, are of this tree. For the deck it is preferred to the true yellow pine, and it is exported for that purpose to Philadelphia, New York, etc., where it is also in request for the floor-

G. Frederick Schwarz, in "The Long Leaf Pine in Virgin Forest" (1907), says: "The first requirement for succession in the forest is a supply of seed. The long leaf pine produces this at a comparatively early age, although the exact period, as with other species, depends in some measure upon modifying conditions, such as the fertility of the soil and the warmth, moisture and light at the disposal of the tree. Seed years come only at intervals, usually about five years apart; but after prolonged periods of rest a seed year is likely to occur that is exceptionally prolific. During a seed year small poles can frequently be seen bearing a few cones, while larger trees bear very heavily. Prolific seed years, or "heavy masts," are known to have taken place in 1845, 1872 and 1892.



PITCH PINE (PINUS RIGIDA). A BRANCH WITH A CONE OF THE NATURAL SIZE: FIG. 1, A LEAF; FIG. 2, A SEED

ing of houses. In certain soils its wood contracts a reddish hue, and it is for that reason known in the dock yards of the Northern States by the name of red pine Wood of this tint is considered the best, and in the opinion of some shipwrights it is more desirable on the side of vessels and less liable to injury from worms than the oak.

The long-leaved pine is the only species exported from the Southern States to the West Indies. A numerous fleet of small vessels is employed in this traffic, particularly from Wilmington, in North Carolina, and Savannah, in Georgia. The stuff destined for the colonial markets is cut into every form required in the construction of houses and vessels. What is sent to England is in planks, from fifteen to thirty feet long, and ten or twelve inches broad. They are called ranging timbers, and are sold at $8 or $10 a hundred cubic feet. The vessels freighted with this timber repair chiefly to Liverpool, where it is said to be employed in the building of ships and wet docks. It is called Georgia pitch pine and sold 25 or 30 per cent. higher than any other pine imported from the United States.

From the diversified uses of the wood an idea may be found of the consumption, to which must be added a waste of a more disastrous kind which it seems impossible to arrest. Since the year 1804 extensive tracts of the finest pines are covered only with dead trees. In 1802 I remarked a similar phenomenon among the yellow pines in East Tennessee. This catastrophe is felt among the Scotch firs which people the forests of the north of Europe and is wrought by a swarm of small insects, which lodge themselves in different parts of the stock, insinuate themselves under the bark, penetrate into the body of the tree, and cause it to perish in the course of a year. (See footnote.)

The value of the long-leaved pine does not reside exclusively in its wood. It supplies nearly all the resinous matter used in the United States in shipping and a large residue for exportation to the West Indies and Great Britain. In this view its place can be supplied by no other species; those which afford the same products being dispersed through the woods or collected in inaccessible places. In the Northern States the lands which at the commencement of their settlement were coverd with pitch pine were exhausted in twenty-five or thirty years, and for more than a half century they have ceased to furnish tar.

The pine barrens are of vast extent and are covered with trees of the finest growth, but they cannot all be rendered profitable from the difficulty of communication with the sea. Formerly tar was made in all the lower part of the Carolinas, and Georgia, and throughout the Floridas vestiges are everywhere seen of kilns that have served in the combustion of resinous woods. At present this branch of the industry is confined to the lower districts of North Carolina, which furnish almost all of the turpentine and tar exported from Wilmington and other ports.

The resinous product of the pine is of six sorts, viz., turpentine, scrapings, spirits of turpentine, rosin, tar and pitch. The last two are delivered in their natural state. The others are modified by the agency of fire in certain modes of preparation. More particularly turpentine is sap of the tree obtained by making incisions in its trunk. It begins to distil about the middle of March, when the circulation commences, and flows with increasing abundance as the weather becomes warmer, so that July and August are the most productive months. When the circulation is slackened by the chill of autumn the operation is discontinued and the remainder of the year occupied in preparatory labor for the following season, which consists first, in making the boxes. This is done in January and February. In the base of each tree about three or four inches from the ground, and of preference on the south side, a cavity is formed, commonly of the capacity of three pints, but proportionate to the size of the trunk, of which it should occupy a quarter of the diameter. On stock more than six feet in circumference two, and sometimes four, boxes are made on opposite sides. Next comes the raking, or the clearing of the ground at the foot of the trees from leaves and herbage, by which means they are secured against the fires that are often kindled in the woods by the carelessness of travelers and waggoners. If the flames gain the boxes already impregnated with turpentine they are rendered useless and others must be made. Notching is merely making at the sides of the boxes two oblique gutters about three inches long, to conduct into it the sap that exudes from the edges of the wound. In the interval of a fortnight, which is employed in this operation, the first boxes become filled with sap. A wooden shovel is used to transfer it to pails, which in turn are emptied into casks placed at convenient distances. To increase the product the upper edge of the box is chipped once a week, the bark and a portion of the alburnum being removed to the depth of four concentrical circles The boxes fill every three weeks. The turpentine thus produced is the best and is called pure dipping.

The chippings extend the first year a foot above the box, and as the distances increase the operation is more frequently repeated, to remove the sap coagulated on the surface of the wound. The closing of the pores occasioned by continued rains exacts the same remedy, and it is remarked that the production is less abundant in moist and cool seasons. After five or six years the tree is abandoned; the upper edge of the wound becomes cicatrized but the bark is never restored sufficiently for the renewal of the process.

It is reckoned that two hundred and fifty boxes yield a barrel containing three hundred and twenty pounds. Some persons charge a single negro with the care of four thousand or five thousand trees of one box; others of only three thousand, which is an easy task. In general three thousand trees yield, in ordinary years, seventy-five barrels of turpentine and twenty-five barrels of scrapings, which supposes the boxes to be emptied five or six times in a season. The scraping is a coating of sap which becomes solid before it reaches the boxes and which is taken off in the fall and added to the last runnings. In November, 1807, the pure dipping was sold at $3 a barrel, and the scrape a quarter less.

In 1804 the exportation to the Northern States and to the English possessions amounted to 77,827 barrels. During peace it comes even to Paris, where it is called "Boston turpentine." Throughout the United States it is used to make yellow soap of a good quality. The consumption in England is great, and in the official statements the value imported in 1807 is $465,828. In 1805 Liverpool alone received 40,294 barrels, and in 1807 18,924 barrels. It was sold there in August, 1807, at $3 a hundred pounds, and after the American embargo in 1808 at $8 or $9. Oddy omits in the list of articles exported from Archangel and

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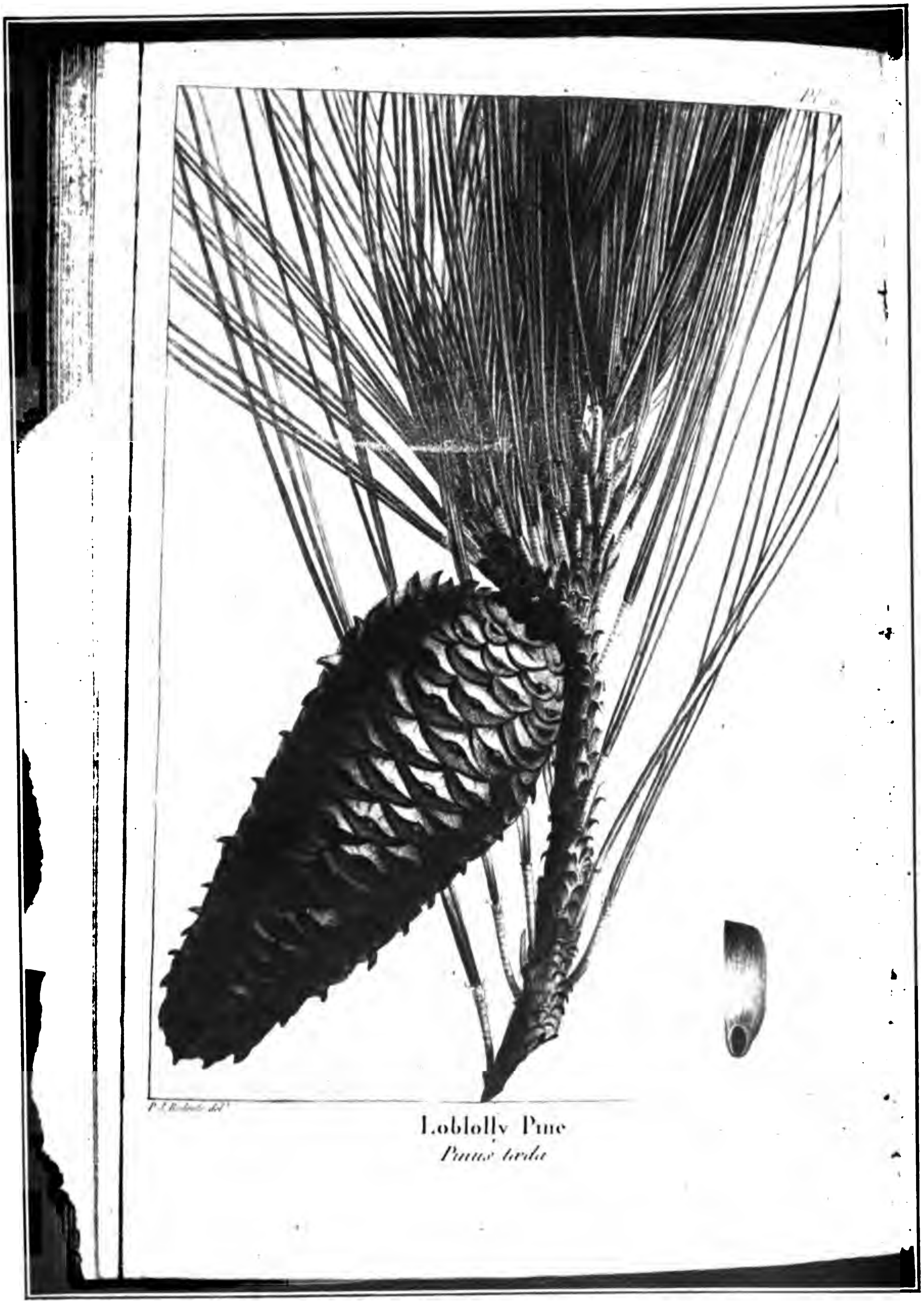
A. D. Hopkins' bulletin (476, U. S. Dept. Agriculture) on "The dying of pine in the Southern States," tells of the ravages wrought by the Southern pine beetle, which may have been the insect whose ravages were told of by Michaux. Says Mr. Hopkins: "It is a small brownish or black beetle, somewhat smaller than a grain of rice. It flies in March to December in the more southern sections, and from May to November in its northern range. It attacks the middle to upper portions of the trunks of healthy pine and spruce trees, causing their death by excavating long, winding burrows or egg galleries, which extend through the inner layers of the living bark and mark the surface of the wood. Eggs are deposited along the sides of these galleries, from which the young grubs (larvae) hatch and then feed on the inner bark until they have attained the size of the parent beetle, when they mine into the outer bark and transform to the dormant (pupal) stage and later to the adult or beetle stage. The beetles then emerge to fly in search of other living trees in which this process of attack and development is repeated. The winter is passed in the bark of the living and dying trees in all stages of development. The more advanced individuals begin to emerge and fly in March to May and the remainder continue to develop and emerge until about the last of July, so that by this time all of the trees that were attacked during the previous fall and early winter are completely dead and abandoned by the beetles. There are from three to five generations annually. The first generation begins with the eggs deposited by the first beetles that fly and attack the trees in the spring and by those of the overwintered broods as they make successive attacks during the spring and early summer. The second generation begins with the eggs deposited by the adults of the first generation and so on until cold weather stops their activities. Under normal or average conditions of the activities of this beetle a few scattering trees are killed by it each year in nearly every county throughout the Southern States where the pine is common. If, however, there are from any cause favorable conditions for the multiplication of the insect, it is able to kill groups of trees and if these groups increase in number and size the following year they constitute the danger signal of an outbreak which may result in widespread depredations."



LOBLOLLY PINE (PINUS TAEDA). A BRANCH WITH A CONE OF THE NATURAL SIZE.
FIG. 1. A LEAF: FIG. 2. A SEED

Stockholm to Great Britain the resinous products of the pine, which had amounted to 100,000 barrels of tar in a year.

A great deal of spirits of turpentine is made in North Carolina. It is obtained by distilling the turpentine in large copper retorts, which are of an imperfect shape, being so narrow at the mouth as to retard the operation. Six barrels of turpentine are said to afford one cask of one hundred and twenty-two quarts of the spirit. It is sent to all parts of the United States, even to the Western country, by way of Philadelphia; to England, and to France, where it is preferred, as less odorous, to that made near Bordeaux. In 1804, 19,526 gallons were exported from North Carolina. The residuum of the distillation is rosin, which is sold at one-third of the price of turpentine. The exportation of this substance in 1804 was 4,675 barrels.

All the tar of the Southern States is made from dead wood of the long-leaved pine, consisting of trees prostrated by time, or by the fire kindled annually in the forests, of the summits of those that are felled for timber, and of limbs broken off by ice which sometimes overloads the leaves. It is worthy of remark that the branches of resinous trees consist almost wholly of wood of which the organization is even more perfect than in the body of the tree. The reverse is observed in trees with deciduous leaves. The explanation of the phenomenon I leave to persons skilled in vegetable physiology. As soon as vegetation ceases in any part of the tree its consistence speedily changes, the sap decays and the heart, already impregnated with resinous juice, becomes surcharged to such a degree as to double its weight in a year. The accumulation is said to be much greater after four or five years. The general fact may be proved by comparing the wood of trees recently felled and of others long since dead.

To procure the tar, a kiln is formed in a part of the forest abounding in dead wood. This is first collected, stripped of the sap, and cut into billets two or three feet long and about three inches thick, a task which is rendered long and difficult by the knots. The next step is to prepare a place for piling it. For this purpose a circular mound is raised, slightly declining from the circumference to the center, and is surrounded with a shallow ditch. The diameter of the pile is proportioned to the quantity of wood which it is to receive. To obtain one hundred barrels of tar it should be eighteen or twenty feet wide. In the middle is a hole with a conduit leading to the ditch, in which is formed a receptacle for the resin as it flows out. Upon the surface of the mound, beaten hard and coated with clay, the wood is laid round in a circle like rays.

The pile, when finished, may be compared to a cone truncated at two-thirds of its height and reversed, being twenty feet in diameter below, twenty-five or thirty feet above, and ten or twelve feet high. It is then strewed with pine leaves, covered with earth, and contained at the sides with a slight cincture of wood. This covering is necessary in order that the fire kindled at the top may penetrate to the bottom with a slow and gradual combustion. If the whole mass was rapidly inflamed the operation would fail and the labor in part be lost. In fine, nearly the same precautions are exacted in this process as are observed in Europe in making charcoal. A kiln which is to afford one hundred or one hundred and thirty barrels of tar is eight or nine days in burning. As the tar flows off into the ditch it is emptied into casks of thirty gallons, which are made of the same species of wood.

Pitch is tar reduced by evaporation. It should not be diminished beyond half of its bulk to be of good quality.

In 1807 tar and pitch were exported to England from the United States to the amount of $265,000. The tar was sold at Liverpool in August of the same year at $4.67 a barrel, from which inferences may be drawn to the advantage of the United States. At Wilmington the ordinary price is from $1.75 to $2.20 a barrel.

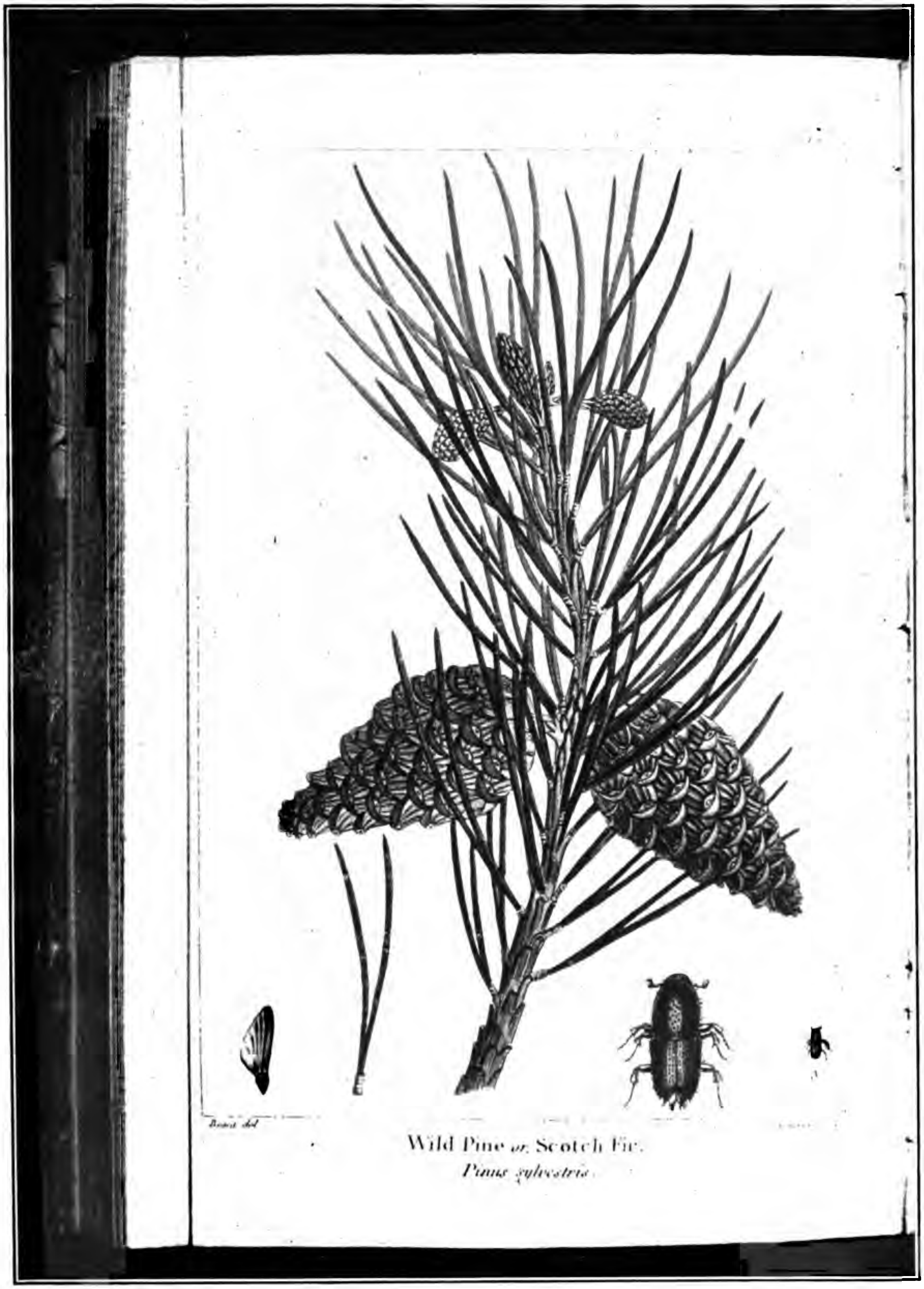
Oddy informs us that the tar brought to England between 1786 and 1799 came in equal proportions from Russia, Sweden and the United States. Only a very small quantity was drawn from Denmark. The Swedish tar is most highly esteemed in commerce and next that of Archangel. That of the United States is considered inferior to both, which is owing to its being made from dead wood, while that of Europe is extracted from trees recently felled. I shall speak more particularly of the differences arising from this cause in the description of the pitch pine. The tar of Carolina is said to also contain earth. This can be attributed only to the want of care in preparing the receptacle. If the same pains were taken in the fabrication it would probably equal that of Europe, though it must be considered that the tar of Russia and Sweden is produced by a different tree, a native of the north of Europe. It has already been remarked that in the United States this manufacture is confined to the maritime part of North Carolina, and to a small tract of Virginia, but ,according to the rate of consumption in America and Great Britain, the product would not long suffice if all the extensive regions covered with the long-leaved pine were made to contribute to this object; for the dead wood is said not to be renewed upon a tract that has been cleared in less than ten or twelve years. It might be advantageous to make use of green wood, or purposely to strip the trees of their bark, and perhaps in this way supplies might be obtained equivalent to the demands of commerce.

Great benefit would result from striping the pines of a certain diameter of their bark; they would pass completely into the resinous state in fifteen months and would be proper for posts and many other uses which require strong and lasting wood. This experiment, which I should have tried when I was last in South Carolina, if the season had not been too far advanced, should be made in April or the beginning of May, while the sap is in active circulation, and the fiber, or inner bark, should be exactly removed.

I cannot conclude this protracted article without expressing a wish that the long-leaved pine should be introduced upon the wastes near Bordeaux; the soil and climate are perfectly congenial to it, and it would succeed better than in the more northern departments. It would be a valuable addition to our domestic resources, for its wood is superior to that of any pine of North America, and as I have proved by comparison, to that of the Bordeaux and Riga pines. The red and yellow pines, also, are shown to be superior to these European species by samples which I brought from America.

PITCH PINE, or Pinus Regida, known in all the United States by the name of Pitch Pine and sometimes in Virginia by that of Black Pine. Except the maritime part of the Atlantic States and the fertile regions west of the Allegheny Mountains, it is found throughout the United States, but most abundantly on the Atlantic coast, where the soil is diversified but generally meager. The vicinity of Brunswick, in the District of Maine, and of Burlington on Lake Champlain, in the State of Vermont, are the most northern points at which I have observed it. In these places it commonly grows in light, even, friable, sandy soils, which it occupies almost exclusively. It does not exceed twelve or fifteen feet in height. And its slender branches, laden with puny cones, evince the feebleness of its vegetation. * * * *

The Pitch Pine seems to have formerly abounded in Connecticut, Massachusetts and New Hampshire; for, since the beginning of the seventeenth century, till 1776 they have furnished a certain quantity of tar. About the year 1705, upon a misunderstanding with Sweden, whence she had drawn her supplies, Great Britain encouraged this branch of industry in the northern part of America by a premium of one pound sterling for eight barrels of tar made from dead woods, and of two pounds for the same quantity extracted from green trees. The method of depriving the trees of their bark and felling them the following year, whose excellence has since been proved by Buffon's experiments in the conversion of alburnum into perfect wood, and which might be profitably applied in the United States, was published and disseminated. In consequence of this encouragement or from other causes, the destruction has been so rapid that the Northern States



WILD PINE OR SCOTCH FIR. (PINUS SYLVESTRIS.) PLATE: A BRANCH WITH A CONE OF THE NATURAL SIZE. FIG. 1. A LEAF: FIG. 2. A SEED: FIG. 3. BOSTRICHUS PINIPERDA OR DERMESTES TYPOGRAPHUS, OF NATURAL SIZE. FIG. 4. THE SAME INSECT ENLARGED

no longer furnish turpentine or tar for their own consumption. The little tar that is made on the shores of Lake Champlain is used in the small vessels that ply upon its surface, or is sent to Quebec. A few of the poorer inhabitants in the maritime part of New Jersey live by this resource and the product of their industry is sent to Philadelphia where it is less esteemed than the tar of the Southern States. What is required for the few vessels that are annually launched on the Ohio is obtained at an exorbitant price from the Allegheny Mountains and from the borders of Tar Creek which empties into the Ohio twenty miles below Pittsburgh. The essence of turpentine used in the western country in painting is drawn from Philadelphia and Baltimore.

LOBLOLLY PINE, or Pinus Talda, is commonly called the Loblolly Pine throughout the lower part of the Southern States, and sometimes White Pine about Petersburgh and Richmond, in Virginia. I observed it for the first time near Fredericksburgh, 230 miles south of Philadelphia, and I believe it does not exist much farther north. In the lower part of Virginia and in the districts of North Carolina situated northeast of the River Cape Fear, over an extent of nearly two hundred miles, it grows wherever the soil is dry and sandy; on spots consisting of red clay mingled with gravel it is supplanted by the Yellow Pine and by different species of oak. The two pines are regularly alternated, according to the variation in the soil and frequently vanish and reappear at intervals of four or five miles.

In the same parts of Virginia this species exclusively occupies lands that have been exhausted by cultivation, and amid forests of oak tracts of one hundred or two hundred acres are not unfrequently seen covered with thriving young pines. In the more southern States it is the most common species after the Long-Leaved Pine, but it grows only in the branch swamps or long, narrow marshes that intersect the pine barrens, and near the creeks and rivers, where the soil is of middling fertility and susceptible of improvement, such as is the vicinity of Charleston, S. C., which is covered to the distance of five or six miles with Loblolly Pines.

The leaves are fine, of a light green, six inches long and united to the number of three, and sometimes of four on young and vigorous stocks. The bloom takes place in the beginning of April, the aments are nearly an inch long and are bent and intermingled like those of the Long-Leaved Pine. The cones are about four inches in length, and armed with strong spines; while closed they have the form of an elongated pyramid, and when open of a strombus more or less perfect. The seeds are cast the first year. The tree exceeds eighty feet in height, with a diameter of two or three feet and a wide spreading summit. This wood has a greater proportion of sap than that of the pond and pitch pines. * * * It specially possesses itself of deserted lands and renders a long labor necessary to clear them anew for cultivation. * * * It remains to be proved whether it would not grow more rapidly than the maritime pine on the plains of Bordeaux. * * * It affords turpentine in abundance, but in a less fluid state than that of the Long-Leaved Pine; as it contains more alburnum, from which the turpentine distils; perhaps by making deeper incisions it would yield a greater product.

YELLOW PINE: In the Middle States, where it is abundant, and in common use it is called yellow pine; in the Carolinas and Georgia, spruce pine; and more frequently short-leaved pine. The heart is fine grained and moderately resinous, which renders it compact without great weight. Long experience has proved its excellence and durability. In the Northern and Middle States and Virginia, to the distance of one hundred and fifty miles from the sea, nine-tenths of the houses are built entirely of wood and the floors, the casings of doors and wainscots, the sashes of the windows, etc., are made of this species as more solid and lasting than any of the other indigenous woods. In the upper part of the Carolinas where the cypress and white cedar do not grow the houses are constructed wholly of yellow pine and are even covered with it. The yellow pine in boards from an inch to two and one-half inches thick, forms a considerable article of exportation to the West Indies and Great Britain. In the advertisements of Liverpool it is designated by the name of New York pine, and in those of Jamaica by that of yellow pine. In both places it is sold at a lower price than the long-leaved pine of the Southern States, but much higher than the white pine. Though this species yields turpentine and tar their extraction demands too much labor, as it is always mingled in the forests with other trees. The value of its wood alone renders it for the Middle and North of Europe the most interesting except the red pine, of the American species.

WILD PINE, OR SCOTCH FIR, Pinus Sylvestris. The pines of the old continent are less numerous than those in North America. Among them the wild pine is the most valuable for the properties of its wood. It is, besides, extensively diffused and grows in the most dissimilar soils. In that part of Europe which lies above the 55th degree of latitude are found immense forests of resinous trees, in general composed entirely of this species; below that parallel the leafy trees begin to mingle with them and soon exclude them from the forests. In the center of Europe the wild pine abounds only in the coldest and most elevated situation, such as the Pyrenees, the Tyrolinian, Swiss and Vosges mountains. In Scotland it is so common as to leave no doubt of its being indigenous to that kingdom, though some authors believe it to have originally come from the continent. The tree arrives at perfection only in the North of Europe, where it is more than eighty feet high and four or five feet in diameter. The full grown trunk is covered with a thick and deeply furrowed bark, the leaves are in pairs, of a pale green, stiff, twisted and about three inches long; the flowers are of a yellowish tint and the cones are greyish, of a middling thickness and a little shorter than the leaves. Each scale is surmounted by a retorted spine, the seeds are small, black and garnished with a reddish wing. They ripen the second year. The great elevation of the wild pine, its uniform diameter, and the excellent quality of its wood resulting from a just proportion of resinous fluid renders it peculiarly proper for the masts of large ships and for an infinite variety of secondary purposes. A considerable exportation takes place from the North of Europe, especially from Riga, Menell and Dantick, to the maritime states, particularly to England, where, according to Sir A. B. Lambert, it is known by the name of red deal, and in London by that of yellow deal. In Poland and Russia the houses are generally constructed of it. This species furnishes four-fifths of the tar consumed in the dock yards of Europe, which is exported from Archangel, Riga and other ports of Russia and Norway. The faculty which I have ascribed to the wild pine of growing in climate, soils and exposures extremely different, is of inestimable value and its cultivation has been successfully attempted on lands abandoned during ages of hopeless sterility. Plantations may be formed from the seed or with young stock from the nursery. Of all the pines this species bears transplanting with the least injury. It is seen flourishing on sandy wastes exposed to the saline vapors of the sea, and, which is more re-

markable, on calcarious lands, a large tract of which, in the Department of the Marne, called la Champage Pouilleuse, has begun, within forty years, to be covered with it after lying desert from time immemorial. The proprietors who first conceived this fortunate plan have already seen their barren grounds acquire a ten-fold value. The oldest plantations yield seeds which are disseminated by the winds, and spring up spontaneously. After the first growth of evergreen trees the soil becomes capable of sustaining the beech, the hornbeam, the oaks, etc., which in time render it proper for the producing of cereal plants. In Belgium large heaths have in this way been transformed into rich arable lands. The culture of the wild pine has been found so profitable that seeds or young plants may everywhere be obtained at a moderate price. April is the most favorable season for sowing the seeds or removing the young stocks. Six or eight pounds of seed should be scattered upon an acre of ground previously sown with half the usual quantity of oats. The roller suffices to cover them. The oats preserve a degree of coolness in the soil, and shelter the young pines from the ardor of the sun but great care must be taken not to injure them in the harvest. The wild pine might profitably be cultivated on waste land in the Northern section of the United States.

NEW JERSEY PINE, or Pinus Inops, abounds in New Jersey. It is found in Maryland, Virginia and Kentucky, and in Pennsylvania, where it is called scrub pine. Near Mudlick, in Kentucky, a small quantity of tar is obtained from the heart and is consumed in the vicinity. It is the most uninteresting species in the United States. Its size forbids the useful employment of its wood.

MAKING TAR, PITCH AND ROSIN IN THE PROVINCE OF NORTH CAROLINA IN 1730

(By Dr. John Brickell.)

[Dr. John Brickell, who wrote the "Natural History of North Carolina," from which the following is taken, lived in Edonton, that Province, about 1730-31. His book was published at Dublin, Ireland, in 1737, and his account of naval stores operations is one of the earliest of American records on the subject.]

THE PINE TREES, whereof there are four sorts, if not more. The Pitch Pine is a very large, fair Tree, free from Boughs or Branches, 'till you come near the top, and continues green all the year, like the Fir Tree; its Timber is much redder than the former and its Leaves narrower, shorter, and more sharp pointed like the Pine; their Fruit is Scaly, the Bark of the Tree is blacker, tougher and more flexible than that of the Fir Tree. The Wood of this Tree being so full of Bitumen, or Turpentine, and is so durable that it seems to suffer no decay, though exposed to all Weathers, or lying upon the Ground or in Water for many Ages; and is used in many domestic Affairs. This Tree affords four excellent Commodities, viz. Turpentine, Tar, Pitch and Rosin; how they are made I shall treat of in another place.

The White and Yellow Pine grow to be very large Trees, much after the same form with the former, but it's Leaves are larger and the Wood is not so full of Turpentine, therefore more easy to be sawed, it affords excellent good Plank for Building and several other uses. They make Masts, Yards and several other Necessaries of this Pine, being the most useful Tree in the Woods.

The Almond Pine, this last bearing Kernels in the Apple, tasting much like Almonds; for which Reason it is called: it much resembles the former in bigness and groweth, is used for Masts, Boards, Piles, Fence and several other things.

It will not be improper in this place to give an account how the Turpentine, Tar, Pitch and Rosin are made, being all the produce of one Tree, and a very good Stable Commodity in these parts. The Planters make their Servants or Negroes cut large Cavities on each side of the Pitch Pine Tree (which they term Boxing of the Tree) wherein the Turpentine runs, and the Negroes with Ladles take it out and put it into Barrels; These Trees continue thus runn most commonly for three Years, and then decay, but in process of time fall to the Ground, which is what they call Light Wood, of which their Pitch and Tar is made.

The Planters, at certain Seasons of the Year and especially in Winter, make their Negroes gather great quantities of this Light Wood, which they split about the thickness of the small of a Man's Leg, and two or three Feet in length; when they have got a sufficient quantity of it in readiness they set their Kilns on some rising Ground or Earth thrown up for that purpose in the center whereof they make a hollow place, from whence they draw a Funnel some distance from the Kiln. Then they take the Light Wood, which they pile up with the ends of each placed slanting towards the center of the Kiln, which is generally made taper from the Ground, afterwards they cover it very secure with Clay, Earth or Sods to keep in the Flames. After this is done they set it on fire at the Top, the Weather permitting, which must be neither too dry nor too wet. By this means the Tar runs into the center and from there into the Funnel, where they attend Night and Day (with Ladles to put it into Barrels prepared for that purpose) till the Kiln is quite burnt out, which is generally in eight and forty hours or less, according to the dimensions of the Kiln. It sometimes happens through ill management and especially in too dry Weather, that these Kilns are blown up as if a train of Gunpowder had been laid under them, by which Accident their Negroes have been very much burnt or scalded. The Planters generally know very near what quantity of Tar each of their Kilns will produce, according to their dimensions, for which reason they are always provided with a sufficient number of Barrels for that end.

The Pitch is made of the Tar, which is done in the following manner.

They have large Furnaces, made in several parts, and more now than ever, by reason of a late act of Parliament made in the Reign of his present Majesty, which obliges every Person or Persons that burn Tarr Kilns in his Majesties dominions in America to make half of the first running into Tar, and the other half into Pitch, the penalty being a forfeiture of the whole. With the second running they fill their furnaces and so place a fire underneath it till such time as it begins to boyle, then they set it on fire and burn it to the consistency of Pitch.

The Rosin is very scarce in these parts, few giving themselves the trouble; but when it is made, it is done after the following manner, viz. Take Turpentine, as much as you think proper, put it into an Alembick or a Copper Vesica, with four times its weight of fair Water, and distil it, which will produce a thin and clear Oil like Water, and at the bottom of the Vessel will remain the Rosin. The Indians never make either Pitch, Tar or Turpentine, ranging and hunting continually through the Woods, being all the Industry they are given to, except they plant some small quantity of Indian Corn or Maize, and dress their Deer Skins, being as well satisfied with this way of living as any among us who by his Industry has acquired immense Treasure.

EARLY HISTORY OF THE NAVAL STORES INDUSTRY IN NORTH AMERICA

OVER THREE HUNDRED YEARS AGO TURPENTINE WAS TAKEN FROM THE TREES OF NOVIA SCOTIA

(By Thomas Gamble, Editor Weekly Naval Stores Review, Savannah, Ga., 1890-1920)

THE NAVAL STORES INDUSTRY IN EARLY COLONIAL VIRGINIA

CORRECTION: On page 17, second column, beginning eleventh line from the bottom, should read: "Jamestown was settled in 1607, one year after the adventurous French had drawn turpentine from the meagre and sluggish veins of the Nova Scotia trees, and in all probability converted the wood into pitch and tar. Three years later, 1610, there were drafted," etc. In this connection it may not be amiss to give the following additional data about the industry in Virginia, found scattered through the exceedingly valuable two volumes on the "Economic History of Virginia," by Philip A. Bruce, corresponding secretary of Virginia Historical Society, published by the MacMillan Co., 1907. The third important motive in which the colonization of Virginia had its origin, was the expectation that the new country would supply a large number of articles which the English people at that time were compelled to buy from foreign nations. The Muscovy Company (organized in 1554) always derived the greatest part of its profits from the importation to England of tar, pich, rosin, flax, cordage, masts, yards, timber and other naval stores, and also glass and soap ashes. These were the products of Russia and Poland, a large portion of the surface of these countries being covered with magnificent forests. The area of the English forests was small and was steadily diminishing. The Muscovy Company, which was the principal agent in the accumulation of naval stores in England, was exposed to many obstructive influences. First, it had to contend with the fickleness of the population and government of Muscovy; little reliance could be placed upon their stability and fidelity either in private contracts or public treaties. The Dutch had now enlarged the volume of their trade with Russia, thus introducing a competition that curtailed the English dealings and lowered the profits of all bargains made. It was a serious disadvantage that the company could only send out an expedition to Russia at one season in the year, the ice of the northern waters offering at other times impassable obstacles to navigation. There was a constant danger that the King of Denmark would increase the tax imposed upon the cargoes of all foreign vessels passing in and out of the Baltic, while the Hanse communities south of Denmark were always seeking to deprive the Muscovy Company of the right of way in the northern seas. In 1608 eight Dutchmen and Poles were dispatched to Virginia who were to be employed in the manufacture of glass, pitch, tar, soap, etc. When Capt. Newport returned to England in the same year he brought back, as a part of his cargo, the accumulation of these commodities which had been provided for him, and in his frame of mind at that time they must have appeared a rather poor substitute for the lump of gold, the members of the lost Roanoke colony, or the proof of the nearness of Virginia to the South Sea, which he had, on leaving England, been commanded to find. (This was the first naval stores shipped from what is now the United States to England, as far as known, and makes the naval stores industry this year (1921) three hundred and thirteen years old in this country. —T. G.) Capt. John Smith, in his memorable letter to the Treasurer and Council in England, in 1608, said with reference to the manufacture of tar, pitch, etc., that at that time it was a waste of money, as the factors of the company could buy in Northern Europe in a week as much of these commodities as would be required to load a ship. Time and again, though, efforts were made to divert attention from tobacco to these staples, but without success. In the territory coincident with that of the present day Virginia the pine trees were only very numerous on the coast and along the shores of the Bay and at the mouths of large streams. That the tree, as a rule, was dispersed at the period of the earliest settlement is disclosed by the fact that in a communication from the authorities in Virginia to the Company in London, written in 1622, the statement is made that pitch and tar could never become staple commodities of Virginia because the pines were so scattered that it would be unprofitable to bring them together. In the valuation of Virginia products in 1621, in "Virginia Richly Valued," (Force's Historical Tracts), pitch is given as five shillings per one hundred pounds, tar five shillings per one hundred pounds, turpentine (gum) twelve shillings per one hundred pounds. At that time the purchasing power of money was five to seven times what it is today. In 1664 to encourage the production of tar and pitch in both Virginia and Maryland those commodities were ordered admitted into England for five years without being subjected to the ordinary duties. The English were still importing hemp, tar and pitch, together with other naval stores, from Denmark, Sweden, Norway and Russia. As the English carried little merchandise into those kingdoms they were forced to purchase such indispensable materials principally with coin, thus establishing a balance of trade against their own country, a condition which at that time was considered to be fruitful of many evils, including the impoverishment of the people by the withdrawal of money, and the certain interruption of these supplies in the event of war. The suggestion that the Virginians should furnish pitch, tar and hemp was only extraordinary in the light of the inability of the landowners to obtain these materials from the forest at a cost that would leave some room for profit. In 1698 the only place where pitch and tar were produced in Virginia in a considerable quantity was in Elizabeth City County. The amount did not exceed twelve hundred barrels annually, knots of pine trees being the material used. Barrels of tar were from an early period very frequently included in the inventories of estates in Lower Norfolk County, and the entries of this form of property increased in a very notable degree in the last five years of the century. This commodity became an important consideration in the transfer of titles to land; in some instances it was offered as part payment; in others in whole payment.

remote lands for the increase of his Majesties Quit Rents and for rendering this Colony yet more useful and advantageous to Great Britain by supplying the aforementioned commodity, so necessary for his Majesty's navy, and the increase of shipping and navigation." Minute directions at the same time were given as to the method of making good tar.

Further to the north, in bleak New England, where the pinus rigida were found in the Plymouth and Massachusetts Bay colonies and their offshoots, large quantities of tar and pitch were made within a comparatively few years after their establishment and their manufacture had reached large proportions there before the seventeenth century had closed, just as in the Carolinas where the long leaf pine gave so much more abundantly of its resinous contents. The pines of the New England country were not comparable to those of the southern colonies in that respect and their area was very limited, so limited, in fact, that they soon approached exhaustion, the first to tell the story of what could happen under the system of indiscriminate slaughter of the forests that marks the history of the country. Tar making became one of the first industries of the settlers. Wood, in 1642, in his "New England Prospect," told of the use of the pine knots for candlewood, among the poorer folks, but he could not "commend it for singular good, because it droppeth a pitchy kind of substance where it stands." And Alice Morse Earle, in commenting on this statement, said: "That kind of substance was tar, which was one of the most valuable trade products of the colonists. So much tar was made by burning the pines on the banks of the Connecticut that as early as 1650 the towns had to prohibit the using of candlewood for tar-making if gathered within six miles of the Connecticut river, though it could be gathered by families for illumination and fuel." And as the actual permanent settlement of North Carolina did not begin until 1665 the original "tar burners" of the present United States, it can easily be seen, were the New Englanders whose "Pine tree shillings" and "Pine tree flags" and "Pine tree inns" tell of the part the pine trees played in their early economic and industrial history. But the New England States are small States, and the pines were not allowed to replenish the lands, and there was the ruthless waste that makes later want, and furthermore on Cape Cod, then the land of the Province, wholesale removal of the trees had given full sweep to the sand, the harbors were filling in, the dunes were moving inland, and protective measures were already required, so it came about that as early as 1715 Massachusetts, which has led the way in so much upbuilding and progressive legislation, passed an act of conservation to protect the owners of the pines, perhaps the first legislation of the kind in America. Those early law-makers provided that:

"Whereas, there has been waste and stroy made of pine trees, and other timber within this province: For protection whereof

"Be it enacted by his excellency the governor, council and representatives, in General Court assembled, and by the authority of the same:

"That from and after the publication of this act no person or persons may presume to cut or carry off any tree, or trees, or timber, bark or box any pine tree or trees for the drawing of turpentine standing upon any of the lands belonging to this province, proprietors, townships or particular persons, without leave or license first had and obtained from the owner or owners thereof; on pain of forfeiture and paying the sum of twenty-five shillings for every tree so cut or removed, barked or boxed. And the turpentine drawn from them, when found either in the trees aforesaid, barrels or other vessels lying upon the said lands, to be alike forfeited; one moiety thereof to the respective owners of the land and trees, the other moiety to be to him or them that shall inform or sue for the same, before any justice of the peace in the county where the offense is committed, if the forfeiture exceed not forty shillings, but if above that value, in any other of his majesty's courts of record within this province."

Tar Making America's First Widespread Industry.

The expression about boxing the trees and seizure of that turpentine found in the boxed trees, indicate that the boxing of early colonial Massachusetts was about the same as that now practiced. Despite legislation the pine trees disappeared and before the skirmish at Concord bridge and on Lexington green the industry had shrunk to small proportions while far to the south it loomed into steadily expanding importance. New England's supremacy as a tar and pitch and turpentine making land had been short lived and the seat of manufacture was transferred to the Carolinas, from whence in 1715 Governor Craven (South Carolina) after the uprising of the Yemassee Indians, wrote to the Secretary of State at London that "Carolina now supplies so great a quantity of rice, peas, pitch, tar and other naval stores as to be of great consequence to Great Britain that the need of help is absolute," and urging that "so fine a colony should not be lost for want of men and arms." That was over two centuries ago and so far as pitch and tar are concerned the northern part of the old colony of Carolina still holds the premiership, although every southern State from Virginia to Alabama was the scene of tar-burning operations during the late period of colonial and early revolutionary history. The older Michaux, in 1786, noted the naval stores operations in the Carolinas. The younger Michaux, in 1802, found "Throughout Florida vestiges everywhere of kilns that have served in the combustion of resinous wood," and William Bartram, son of the "Father of American botany," and himself a famous man in that study, in his "Travels in North and South Carolina, Georgia and Florida," tells us that in 1773 a day or two's trip from Mobile, probably while on the Pearl river in what is now Mississippi, accompanied by the captain of the river trading boat, he made "an excursion into the spacious level forests which spread abroad from the shore to a great distance back, observed vestiges of an ancient fortress and settlement, but what principally attracted my notice was three iron pots or kettles, each of many hundred gallons content. Upon inquiry my associate informed me they were for the purpose of boiling tar into pitch, there being vast forests of pine trees in the vicinity of this place. In Carolina the inhabitants pursue a different method, when they design to make pitch: they dig large holes in the ground, near the tar kilns, which they line with a thick coat of good clay, into which they conduct a sufficient quantity of tar and set it on fire, suffering it to flame and evaporate a length of time sufficient to convert it into pitch, and when cool ladel it into barrels, and so on until they have consumed all the tar or made a sufficient quantity of pitch for their purpose." Indeed, from all the evidence the making of tar and pitch may be regarded as the first widespread industry of America, begun in the days of the first settlement, extending to all parts of the Atlantic coast and a large part of the Gulf territory, and persisting unto the present time, although of diminishing importance and now largely localized to North Carolina, where it reached and retained proportions never known elsewhere on this continent, giving to its people the distinctive sobriquet of "Tar heelers," and their commonwealth that of the "Tar Heel State."

Turpentine, (that is, the crude gum), tar and pitch were the commodities sought. Rosins were in little request, it seems, and spirits turpentine likewise did not become an American product for many years, such as was made being distilled on the other side of the Atlantic. Dr. John Brickell pointed out in 1737 that "The rosin is very scarce in these parts." Old Samuel Johnson probably expressed the popular feeling of his day as to naval stores products when on that picturesque trip through the Hebrides in 1773 his ever faithful Boswell noted down that the learned Doctor said: "I remember I used to think tar dirty, but when I knew it to be only a preparation of the juice of the pine I thought so no longer," which might lead one to philosophise on how many other current im-

pressions would be amended if the facts were known. Perhaps the learned lexicographer had gone somewhat deeply into the story of tar and pitch when working on his dictionary. His definitions have their interest. Here they are, with their quaint illuminating quotations, the clearest exposition of the accepted meaning of the terms in 1755:

Colophony. n. s. [from Colophon, a city, whence it came.] Rosin.

"Of Venetian turpentine, slowly evaporating about a fourth or fifth part, the remaining substance suffered to cool, would afford me a coherent body, or a fine colophony."—Boyle.

"Turpentines and oils leave a colophony, upon a separation of their thinner oil."—Floyer on the Humours.

Naval Stores. [naval, Fr.; navalis, Lat.] Belonging to ships.

"Masters of such numbers of strong and valiant men, as well as of all the naval stores that furnish the world."—Temple.

Pitch. n. s. [pic, Sax.; pix, Lat.] The resin of the pine extracted by fire and inspissated, (i. e., thickened, as a fluid by evaporation).

"They that touch pitch will be defiled."—Proverbs.

"A rainy vapour.
Comes on as blacke as pitch."—Chapman.

"Of air and water mixed together, and consumed with fire is made a black colour: as in charcoal oil, pitch, and links."—Peacham.

"A vessel smear'd round with pitch."—Milton.

Rosin. n. s. [properly resin; resine, Fr.; resina, Lat.] Inspissated turpentine; a juice of the pine.

"The billows from the kindling prow retire,
Pitch, rosin, searwood on red wings aspire."
—Garth.

Tar. n. s. [tarre, Dut; tiere, Dan.] Liquid pitch; the turpentine of the pine or fir drained out by fire.

"Then, foaming tar, their bridles they would champ,
And trampling the fine element, would fiercely ramp."—Spenser.

"A man will not lose a hog for a half-penny-worth of tar."—Camden's Remains.

Turpentine. n. s. [turpentina, Ital.; terebinthina, Lat.] The gum exuded by the pine, the juniper, and other trees of that kind.

"As the turpentine tree I stretched out my branches."—Ecclesiasticus.

"Vertgrease grinded with turpentine, put into a pot, and as you use it warm it."—Peacham on Drawing.

(Spirits Turpentine—No definition given.)

The old doctor was erudite in many ways and not in others. Perhaps it was some antipathy to Bishop Berkeley that prevented him from quoting from that first among American authors and directing the world's attention anew to the reverend's exposition of the virtues of "tar-water" as a medicine expounded by him in 1744. The old Bishop's ideas are said to still survive in France among the peasantry. He may have obtained them himself while living in Rhode Island, who knows? The more one pries into this matter of naval stores the more the side lights that illuminate and give surprising interest to it. What a delight it would be to follow the old Greeks over to Colophon in Ionia, Colophon with its famous finishing-stroke cavalry, and find how it was they came there to get their rosin, and how it was made and from what trees. It is a far reach from the tar burners of Carolina through all the intervening ages to ancient Colophon, yet the threads of industrial history bind up the two. The romance of trade and of industry is not excelled by the romance of politics and of war, but unfortunately the stress of study has always been to the latter.

A Bounty Fixed for Tar and Pitch.

But this is almost a world-wide detour from American colonial products. Let us go back to North Carolina and follow the development of the industry there. After 1665 colonists poured into the pine woods, establishing their homes on the water courses as the locations easiest of access and offering the only available outlet for their products. Little ports sprang into being, Boston, Newbern , Wilmington, and through them came access to the markets beyond. Once the matter of food supplies was solved the pioneers' attention was centered, as everywhere else, on trading commodities, the money crops with which commercial relations might be established with other colonies and other lands. The greatest source of such staples lay about them in the unbroken pine forests. Slowly the naval stores industry developed side by side with the growing of rice and corn and hemp, hampered, though, by the high freight rates across the ocean. England, with all the wealth of the colonial forests to draw from, still remained a good customer of the northern producers of Europe. So in 1704 "considerations were humbly offered why naval stores cannot be brought in great quantities from her Majesty's plantations unless assistance be given by the government." This petition set forth that it "was foreseen fifty years since (1654) that it would be dangerous to depend upon the Northern crownes for naval stores and then taken into consideration to be supplied from the plantations in America." "Yet few have been brought tho in those parts there is great plenty of timber for building of ships and also to produce pitch, tarr and rosen, and a soil capable to afford hempe." "Too great a burden which lyes on these commodities, by the great wages paid to laboring men on the plantations and the high freight rates given to ship-masters for goods brought from those parts, which being farr above the rates which are paid for the same sort of goods if they come from Norway or the Baltick deprives the traders of making proffit by these goods from the plantations and gives a priority to those from the North." It was accordingly urged that a great "custome" be put on these commodities from the North "and those from the plantations be eased from all custome" or the goods brought freight free, or a rebate furnished the planters or owners.

The "free trader" was then absent among the "Tar Heelers" and the bounty seekers prevailed and evidently triumphed. The government eventually established a bounty of 10 shillings a barrel on tar and pitch. The production of these commodities grew with the passing of each year, and in February, 1710, a Mr. Byfield presented a memorial at Whitehall on behalf of himself and company "to furnish Her Majesty's navy with pitch and tar from North Carolina." He did not believe these commodities could now be had in Sweden at the rates he offered them for. The production had increased, the quality had improved, the demand had grown, naval stores had become great staples of the Province, and so in 1715 what was perhaps the first law regulating the quality and the package became effective. In that year there was passed an "Act by His Excellency, the Pallatine and the rest of the True and Absolute Lords Proprietors of the Province of Carolina by & with the Advice & Consent of the rest of the Members of the General Assembly now met at Little River for the No. East part of the said Province." This law required pitch and tar barrels to hold thirty-one gallons and a half each, half barrels fifteen and three-quarter gallons, and provided further that "all barrels and half barrels which shall be exposed to sale shall be made of timber seasoned at least six months after the riveing of the staves not less than half an inch when wrought; the heading not less than three-quarters of an inch and well dowelled; twelve good substantial hoops on each cask and the whole to be tight and workmanlike. And every Cooper making Barrels or Halfe Barrels or any other persons making the same before they deliver or expose the same to sale shall set his or her proper Brand Mark upon every Barrel or Half Barrel, which Mark he or they shall cause to be recorded in the office of the Precinct where he or they shall reside or dwell."

It was further provided that on complaint of any person to any Justice of the Peace that "he hath received pitch or tarr that is not good or Merchantable or is not in good or sufficient casks as by the law appointed," there should be assessed "double damages to the party injured and the value of the tar or pitch forfeited to the Church Wardens and vestry for the use of the Parish where such offender lived."

The industry had become a most vital element in the life of North Carolina. As with wool in England in the middle ages, turpentine and tar and pitch had become the recognized staples and standards of value. As Mr. Gordon wrote in his account of his voyage and journey to North Carolina (May, 1709) "In this as in all other parts of the Provinces there is no money. Everyone buys and pays with their commodities. Pitch at 25s. 8d. per barrel, tar at 15s. 2d. per barrel, which prices

though fixed by their laws they can seldom reach for it anywhere else after considerable expense and risk, so that by their computation the difference of their money to sterling is as one to three." The records of the General Court at this time show various orders for the settlement of debts in lots of "Marchantable Pitch," or tar, or turpentine. Here is a sample of such an order handed down on July 28, 1713:

"At General Court for the Province: Ebenezer Whitte comes to pros. his suite agt. Jno. Whitteby and plea of Debt, and Saith ye deft. stands justly indebted to him ye plt in ye sum of tenn pounds tenn shillings in good pitch or tarr and the Dept. in person appeares and confesses." Court ordered accordingly.

Land Rents Paid With Tar and Pitch.

In 1719 the Assembly of South Carolina similarly fixed values for naval stores in the payment of rents for lands. The statute adopted by it "to prevent all disputes that may arise in what the lords' rents shall be paid," enacted that "all rents in arrears, or that shall hereafter become due to the lords proprietors shall be paid either in lawful money, according to the statutes of the sixth of Queen Ann, or else in good, merchantable rice, at the rate of seventeen shillings and sixpence per hundred; or good pitch, at the rate of fifteen shillings per barrel, or tar at the rate of seven shillings and sixpence per barrel." This would also indicate that rosin was not made and that the products of the pine were practically limited at that time to tar and pitch.

Under such conditions, with currency almost absent, fixed bases for trading purposes were essential. So in 1723 an act was passed by the North Carolina Assembly: "Whereas, through the great industry of divers of the inhabitants of the Province the making of hemp, rice and turpentine would become more valuable species in trade in that government if due encouragement were given for making the same by rateing them at a certain price and making them equal in their currency with the staple commodity of this government, such person or persons to whom money shall be due either in the publick or private accounts shall take and receive the same in any of those species as well as those hereinbefore rated and at the rates hereafter appointed, or in public bills of credit." Turpentine was then rated for this purpose at one lb. 5 shillings, 8 pence per merchantable barrel full gauge of 31 gallons. And again in 1728 another Act established by law values for such "rated commodities" as follows: Pitch, per bbl. 1 pound; tar, 12 shillings 6 pence; turpentine 1 pound, 5 shillings.

By this time the trade in such commodities had reached considerable proportions. In November, 1720, a memorial from Mr. Boone and Mr. Barnwell in relation to North Carolina, addressed to "your Lordships," spoke of the exports from North Carolina by small sloops to New England, and said: "Of late they made about 6,000 barrels of pitch and tar which the New England sloops first carry to New England and then to Great Britain." Other direct exportations were doubtless made to England. Bath was at this time the point of export. On August 1, 1716, an order was signed by "John, Lord Cartaret, palatin," and others, at St. James, "erecting a port at the town of Bath in the county of Bath," as "the most proper place in the Province for ships to take in masts, pitch, tar, turpentine and other naval stores for the use of his Majesty's fleet." It is pointed out that at that time the "usual mode in which the traffic of North Carolina was transacted in furnishing vessels with cargoes was necessarily adapted to the geographical aspects of the country. It was not uncommon for small vessels seeking cargo to pass up the various streams to the plantations on the border and there purchase and ship what the proprietor might have to dispose of, selling him commodities at the same time. Pitch and turpentine were among the chief articles thus obtained." "At the planter's wharf sloops, schooners and brigatines were loaded with cargoes of skins, saltpork and beef, tallow, staves, naval stores, lumber, tobacco, corn, rice and other products of the plantation, to be carried to the West Indies and exchanged for rum, molasses, sugar and coffee, or to Boston, Mass., where the proceeds were invested in clothing, household goods, books, negroes, etc. In 1734 Edward Salter, of Bath, in his will directed his executors to load his brigatine with tar and send it to Boston to be exchanged for young negroes," whose descendants some 130 years later were freed by the descendants of those who swapped them for tar in colonial days. The turpentine reshipped from Massachusetts to the English ports received the name of "Boston turpentine," and even as late as the early years of the nineteenth century it is found referred to in English records under that name.

Naval stores soon came under the regulations established by the English government for the control of colonial trade. In 1728 pitch, tar, turpentine, masts, yards and bowsprits were all made "enumerated articles," by which was meant that if exported they were to be first landed in England before they could be carried to any foreign port. This in the end proved a serious inconvenience to the industry and, as will appear later, was a source of complaint from intelligent Governors and merchants. For the time being it did not bear heavily on the industry, the chief drawback of which for many years was the indifference of producers to quality and inclination in some cases to resort to palpably dishonest practices, such as false packing, something not unknown in naval stores in comparatively recent times. Governor Johnston, writing from "Cape Fair," on December 12, 1734, to the Board of Trade at London, gives a clear insight into the methods prevailing and the resultant effect on quality. Said he:

"There is more pitch and tarr made in the two Carolinas than in all the other Provinces on the continent, and rather more in this than in South Carolina, but their two commodities (tarr especially) bear so low a price in London that I find the Planters are resolved to make no more. I believe that it is principally owing to their own conduct that the tarr of this Country is of so small a value for in order to make a large Quantity they make so large and violent fires in their kilns as force all the coarce juices of the lightwood along with the tarr which gives it so hot a quality that masters of ships have said it frequently burnes their ropes which makes them very shy of meddling with it. Now if by a gentle fire they would attempt to make nothing but cool tarr though the quantity would fall short by one third yet in Quality they all agree it would equal East Country Tarr if not exceed it, for their Materials for this Manufacture are excellent and in

great quantity but as the loss of one third of a kiln would fall very heavily upon them they can't pretend to set about this method unless the Crown will be so good as to allow them the old bounty of 10 s. per barrel. If your Lordships approve of this I humbly propose that the Planter in person be obliged to attend the kilns and see that it is cool drawn and to make oath before the Governor that it is so, with heavy penalties in case of fraudes, &C."

The British Board of Trade was governed with sufficient intelligence to appreciate the force of the Governor's comments, and on September 12, 1735, Pelham wrote to Johnston from Whitehall: "We have considered your observations with regard to the manner of making tar in the Province and we are of the opinion that they are right. We think you ought to move the Assembly that some proper regulation might be enacted as rules for making of tar throughout the Province and a proper person or persons appointed to inspect the several kilns that penalties might be inflicted on such of them who transgress the said rules, for although at present (they) endeavor at quantities on account of the bounty, yet if the tar of your province should be brought into disrepute by the burning quality of it none of it will be exported from thence and the manufacture will be quite lost to those of your province who now maintain themselves thereby."

Lawless Tar Burners Punished.

It was about the same time that vigorous steps were taken to stop the encroachment of the tar burners on the pines on lands of the Crown. Writing from Edenton, on October 15, 1736, Gov. Johnston called attention to the fact that "There is a practice of long standing in this colony which has been of immense prejudice to the revenues of the Lords Proprs. formerly and the Crown now, that is the boxing of Pine Trees for Turpentine and burning the lightwood for pitch and tarr, without ever taking out Pattents or paying quit rents for the lands, which has entirely prevented them being taken up by any person, they being generally of little value for any other purpose, and by this means in many parts of the country the lands are waste and not a house to be seen in traveling a great many miles together. A few months after my arrival I published a Proclamation with the advice and consent of Council, offering a reward of 20 lbs. currency to any person who would discover such practices, so that they might be prosecuted in the Court of Exchequer; that has very much disobliged those who used to make great gains by such means." Of course such an interference with what many Carolinians by long practice had come to consider as an "inalienable right" provoked bitterness toward the duty-doing Governor, so much so that Henry McCulloh felt constrained to write the Secretary of the Board of Trade (London, January, 1738) saying: "The Governor has been much censured for the preventing this, therefore it would be of use to him if their Lordships would write to him that they approve his conduct therein." Naturally the Board of Trade approved the policy of the Governor, faithful to the Crown interests.

In 1753 the exports from North Carolina plantations had increased to 61,528 barrels of tar, 12,052 barrels of pitch, 10,429 barrels of turpentine (gum). The industry and trade were increasingly hampered by the restrictions on commerce with foreign countries. North Carolina's predicament was similar to that of the other colonies in some respects. Governor Dobbs wrote to the Board of Trade from Newbern, October 31, 1756, stating that a law had been passed, as per instructions, requiring masters of vessels to give bond that naval stores would only be carried to Great Britain in accordance with the Act of Parliament. The Governor had urged some months before that it would be to the great advantage of the Province if allowed to supply Portugal with naval stores and to import wine and salt from there in return. In 1764 he urged that direct exporting of naval stores be permitted to Ireland, "for which they give bullion to the Northern Nations," and that the colonies be also allowed to ship all kinds of naval stores direct to Spain, Portugal and the Straits and to return with wine, oil, fruit and salt, and the balance in bullion would be remitted to Britain for their manufactures." "Is it not equally surprising," said the sagacious Governor, "that all kinds of naval stores be prohibited to be sent directly to Ireland even without a premium, since it occasions all naval stores to be imported into Ireland from Norway and the Baltick and are paid for in ready money which a so raises the price of naval stores, lumber and deals imported from the North into Britain? Would it not be of great benefit to Britain to prevent the Northern Kingdoms from supplying and vending their naval stores to the Southward and would it not so far lower the price of naval stores and lumber from the Baltick for which Britain and Ireland now remit specie?" The argument was with the governor but his wise counsels did not prevail.

This same Governor Dobbs was not unmindful of the interests of the producers in the Province in other respects, as evidenced by his protest against the sister Province of South Carolina levying a duty on naval stores passing through its territory for export. The war with France and the raising of North Carolina's quota of troops had put heavy financial burdens on the Province. To pay the troops exports of naval stores were essential. Yet, as Gov. Dobbs writing from Newbern, on May 30, 1757, relative to the pay of the soldiers, said: "A duty is laid on naval stores carried from hence to Charlestown by the Southern Province which I think is very impolitic in them as we might send Pitch and Tar sufficient. I have wrote to Governor Lyttleton to endeavor to get that Duty taken off at least so far as what we shall send toward payment of the Troops." The Lords of Trade promptly replied that such a duty "must in its consequence destruct the Commerce of His Majesty's subjects in North Carolina and have an improper effect thereupon, and therefore we shall lose no time in enquiry into this matter and taking such measures as shall appear to us to be proper."

Before this period inspection laws, more or less satisfactory, had been whipped into shape. A sample one, that of 1764, conveys an adequate idea of the endeavors to insure proper packages and maintain the quality of their contents. This act to "prevent the exportation of unmerchantable commodities" provided that "No tar, pitch or turpentine should be exposed for sale for exportation until duly inspected under the regulations." Justices of the Inferior Court were directed to appoint an inspector in each county, except Wilmington, where two and no more were to be appointed. Places and landings for inspection were set forth, making a liberal provision for all of the producing territory. It was set forth that every barrel of pitch or turpentine should contain 31½ gallons and be well filled, free from any fraudulent mixture, and in good and sufficient casks, well hooped with twelve good hoops at least, and before it was branded by the inspector was "to be weighed in his presence and every 322 lbs. weight, including the cask, and so in proportion, should be accounted a lawful barrel." If any pitch or turpentine should be found by the inspector to be fraudulently mixed it was to be condemned and forfeited to the use of the parish and the church wardens were authorized to have it cleaned and sold for such use. Every barrel of tar was to gauge 31½ gallons, wine measure, with 12 hoops at least, and every barrel of tar of less size or in bad and insufficient casks was to be put in merchantable order at the expense of the owner, and when full bound no more than one-third part of the staves should be left bare. "Every barrel of pitch, tar and turpentine inspected, gauged, found

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[The "Board of Trade" referred to above was a department of the government in England designated officially as "the lords of the committee of his Majesty's Privy Council appointed for the consideration of all matters relating to trade and foreign plantations." Cromwell in 1655 was the first to establish a permanent committee for matters of trade. Charles II continued the policy and in 1660 created two separate councils for trade and for foreign plantations, which in 1672 were consolidated into one. In 1786 the present Board of Trade was established as a permanent committee of the Privy Council.]

clean, well filled and truly made merchantable and passed by the inspector shall be by him branded."

The law further provided that every maker of pitch, tar or turpentine must brand every barrel with the initial letters of his or her name and every inspector must keep a book with a record of such names and marks, the number of barrels landed and inspected, the merchant's and shipper's names, and time of inspection, and give a certificate of inspection to any one requiring same on payment of one shilling. If not put on board vessel in twenty days the stuff must be reinspected.

False Packers of Colonial Days.

In 1758 an act was passed which provided that "inasmuch as it is difficult in warm and rainy weather to separate tar from water it is declared that water shall not be accounted a fraudulent mixture in tar but that in such cases the barrels shall not be branded by the inspector until the same is as free from water as it can be made." The masters of ships were made liable to fines for loading pitch, tar or turpentine not branded by an official inspector and in 1766 it was enacted that the brand of the owner's initials should be not less than one inch long and breadth in proportion, under penalty of one shilling for every barrel. Again, in 1770 there was legislation that casks should be made of good, seasoned staves of at least three-quarters of an inch thick and not exceeding four inches in breadth and without sap in the staves.

A bounty had been established and paid on tar and pitch and lumber for a number of years. Governor Tryon writing to the Board of Trade at London on February 22, 1767, stated that "The yellow and pitch pine is equal to any on the continent and vastly superior to that of New England in closeness of texture, weight and durableness, and will sell for one-fourth more than the northward pine when carried to the West Indies markets." He urged a larger bounty than that granted by Parliament for the importation of plank and ton timber into Great Britain from the colonies.

One effect of the bounty, if importers of London are to be believed, was to stimulate practices of false packing, the shipping of rubbish with a coating of tar or pitch, to swell the producer's income. So flagrant had the practice become, if the complaints are true, that in 1770 a memorial from certain merchants trading in naval stores was presented to the Earl of Hillsborough asking that the "following clause of an act passed in the 2d year of his late Majesty's reign" be carried into execution: "Whereas, it is necessary for the better making of cool and good tar fit for cordage in all the British plantations that the last half part of every kiln of tar when drawn shall be made into pitch, free of drops, and the whole kiln of such tar, or the value thereof, unless the said half part be so made into pitch, shall from and after the 29th September, 1729, be forfeited for the benefit of any person or persons who shall sue for the same." After citing this the petitioners asked that officers be appointed by Act of the Assembly of the Province to attend the burning of the tar kilns so this act might be carried out. The petitioners went on to say that "the manner the planters have constantly pursued in burning the tar kilns has been to run it off into open drains cut in the ground and exposed to the weather, by which means rain water often intermixes with the tar while it is hot and when they take the tar out of such drains or reservoirs to fill the barrels, sand, dirt, and water is taken up with it, which your memorialists are of the opinion may be prevented by sinking a large cistern or cask in the ground to receive the tar as it runs from the kiln, with a cover to prevent the rain getting into such cistern or cask when the tar is hot." They further complained that the planters had their barrels made of green timber and so very light that "the leakage before being shipped had been at least 15 to 20 per cent., which is the best and purest tar, besides which the tar burners often bung the barrels at the kiln with grass or weeds, which in rolling to the riverside or place where it is to be delivered often gets into the barrels, many of which are so leaky that the water gets in sufficiently to supply the place of the tar leaked out." They asked for an Act of the Assembly to oblige the planters to put all tar made for exportation into well hooped casks of 32 gallons each, with seasoned pine staves of three-quarter of an inch each stave, the cask to be bunged at the kiln where the tar is burnt with a bung made of cork or wood. They also asked that it be kept in the shade or a cool place. "If this is done" they said, "the tar imported from America into Great Britain will be equal or superior to that from Sweden, which will most certainly recommend it to use in His Majesty's Royal Yards and Navy and become of more general use in all other branches of trade and navigation."

A further serious complaint was that the turpentine imported was found intermixed with sand, dirt, dross, water and chips and in slightly constructed barrels. "We have known many casks imported as casks of turpentine," the outraged merchants declared, "the casks weighing more than 300 lbs. each, in which there has been but a very few pounds of turpentine, the rest being chiefly sand, and for which freight and dues have been paid, the bounty allowed, and insurance made, tho of no real value. Pitch," they said, "is generally imported from North Carolina, half made and intermixed with sand, dirt, dross and stones, which is occasioned by the planters putting the tar into holes dug in the ground and setting fire to the same; when half burnt it is put into slight barrels in a very adulterated condition, which may be prevented by the planters boiling the last half running of the tar kiln into pitch in the kettles, which is the custom of making it in the other colonies, by which means and putting the same into tight, strong barrels made of staves ¾ of an inch thick, well hooped, the pitch will become one-third more valuable to the planter and importer." Not more than one barrel out of twenty imported, it was claimed, was really entitled to the bounty until cleaned, loading it with much expense. The colonial inspectors, it was held, made no pretense of proper inspection for fear of losing their positions.

The bounty on naval stores did not expire until 1774. The memorial did not upset it, but had its effect otherwise. In December, 1770, a committee was appointed by the House of Assembly of the Province to "bring in a bill directing a method of preparing and settling for exportation tar, pitch and turpentine." The next year the British Board of Trade sent out twelve printed copies of the process used in Sweden for the making of tar. President Hassell wrote that he would take due care to distribute them in the best manner to answer the "beneficent and public spirited intention." At this period the exports had grown to 88,000 barrels of crude turpentine, 88,000 barrels of tar, and nearly 21,000 barrels of pitch.

Naval Stores in the Revolutionary Struggle

The war clouds then lowering broke in a few years and the naval stores industry, as in the civil war of 1861-65, rapidly declined. Considerable stocks were on hand at the beginning of hostilities with England, and Congress, on May 21, 1777, ordered that the large collection of tar at Wilmington and all other naval stores should be removed to places of security or destroyed rather than be possessed by the enemy. On February 3, 1776, Congress had provided for the exportation of naval stores from one State to another when wanted. The records of North Carolina show that permission had to be secured from the Provincial Council to move naval stores from the ports of that State. In the stress of the desperate conflict, though, the General Assembly of the newly born Commonwealth found time to protect by laws its greatest industry. In 1778 it provided for inspection fees of 1½d. for tar, 2d. for pitch and turpentine, per barrel, and prohibited the exportation of unmerchantable commodities, providing for justices of the County Courts of Common Pleas to require every inspector to give a bond of 500 pounds current money, and for the establishment of numerous landing places for inspection. Fines and forfeitures, though, were no longer to go to the

parish church, but to the poor. The inspection fees were soon after raised to 2d. for tar and 3d. for pitch and turpentine. The old provision that two-thirds of the barrel of pitch and turpentine should be covered by the hoops was wiped out, but twelve good hoops were still required. The industry was in dire straits during the seven years of devastating conflict, but was continued in a desultory way. Watson, in his journeys in North Carolina in 1777-78, speaks of traversing "a most desolate sandy plain from Edonton to Bath, with here and there a miserable tar-burner's hut," and "coming to New-Bern, a town of 150 dwellings, which previous to the war had exported naval stores." NewBern at one time proudly boasted of its fleet of 110 vessels that carried lumber, tar, etc., to the markets of the North, and to two of its citizens—John and Asa Jones—is accredited the distinction, in the American Universal Geography of 1819, of being probably the first to introduce the distillation of spirits turpentine in the State. At that time, the statement is made, the trees were "hacked with a hatchet."

The experience of North Carolina more or less marked the experience of other tar producing sections. In all of the Atlantic coast country tar was doubtless made in a minor way, a petty income producer on farms and to a type of people satisfied with somewhat meagre returns for its labor. New Jersey in colonial days, for instance, contributed its quota of the tar output of the British possessions, and in the period of 1861-65 again turned to the industry to help alleviate the shortage produced by the cutting off of supplies from the South. In that State today there are great stretches of pine lands where tar and pitch could be made if there were an assurance of profitable prices, but it is doubtful if tar burning will ever again be scheduled among the State's industries. In Georgia quite recently organized efforts at tar and pitch making with more scientific methods have been introduced, but there are no indications that anywhere will efforts be made to wrest the leadership in this respect from North Carolina. Tar and pitch making are very subordinate branches of the industry today, whereas they were paramount from 1630 to 1800 and later.

With the securing of independence and the establishment of the federal government and more normal conditions industrial life once more slowly returned to its former standards and the naval stores production of the Carolinas received an impetus that carried it far beyond the pre-Revolution proportions. New England and other domestic competitors disappeared, the lessons as to the paying virtues of quality in marketing their products were not forgotten, and the Carolinas became practically the seat of the entire industry in America. Wilmington, in North Carolina, became more and more the chief market. By 1800 that port had become one of the largest shipping points in the world for turpentine and tar. In 1804 the shipments from there of crude turpentine alone reached 77,000 barrels. "As the forests of the coastal regions were exhausted the industry moved inland." "The crude turpentine (gum) was brought down the rivers on rafts and in small boats from as high as Edgecombe county to Washington, from Wayne to Newbern, and from all northern tributaries of the Cape Fear to Wilmington. It was distilled in crude iron stills, partly at the shipping point, partly in Philadelphia and New York, while much also went to England, and was there distilled. The spirits of turpentine usually found quick sale and good prices, except when overproduction took place, and was preferred in France to the Bordeaux turpentine. The rosin manufactured was worth very little, getting down as low as 25 cents a barrel (320 lbs.), so low it could not pay to handle it, while the tar and pitch manufactured gave general satisfaction and were made in large quantities."

Later Development of the Industry

The subsequent history of naval stores is told in other articles and tables. Suffice it to say that North Carolina continued the main source of supply until long after the civil war. In 1840 the production of tar, pitch, crude turpentine and rosins for the State was given as 593,451 barrels. In 1860, despite the extension of the industry into other States further south, North Carolina furnished 70 per cent. of all the crude turpentine produced in the United States. It was not until a quarter of a century later that the trecking of the operators and their labor to Georgia brought forcibly to the attention of the world that the forests of North Carolina were rapidly becoming exhausted as a source of supply for naval stores and that its prestige of leadership for two hundred years was about to pass away forever, although in 1883 it was reported that the stand of longleaf pine in fifteen counties of the State was over five billion feet. In 1840 there were 1,526 turpentine plants in the State, with a capital of $2,053,226, and an output valued at $5,311,420. The naval stores industry led all of the industries of the state in the number of plants, capital invested and value of products. A half century later the census gave the State but 174 plants, and in 1905 but 87 plants with an output of 20,000 casks spirits turpentine and 65,000 barrels rosin. At the present time the entire annual production of the State falls below a thousand casks of turpentine and rosins in proportion. The industry there is now almost nonexistent. One good Georgia or Florida turpentine farm in 1920 will produce as much of these commodities as the total production in the "Old North State."

North Carolina reached the maximum of its naval stores production in the decade of 1870 to 1880. In 1872 Wilmington is found handling 112,000 casks of spirits turpentine, 568,000 barrels of rosin, 38,000 barrels of tar, and 18,000 barrels of crude turpentine, the shipments of the last article naturally having shrunk with the home distillation of spirits turpentine from the gum. In 1879-80 the exports from the State are given as 125,000 casks spirits turpentine and 371,000 barrels of rosin. The crop continued a large factor in the financial prosperity of the people for many years after this, although each crop season showed the tendency of production to shrink. In the season of 1890-91 Wilmington handled nearly 68,000 casks of spirits turpentine and over 366,000 barrels of rosin, whereas ten years later its receipts had dwindled to 25,500 casks spirits turpentine and 181,000 barrels rosin. Today the receipts are so unimportant that the statistics are no longer kept.

The foreign shipments of rosins and spirits turpentine from the entire United States were inconsiderable for many years, but the equivalent of 980 casks of spirits and 1,722 barrels of rosin (500 lbs.) in 1800. It was not until after 1820 that these commodities began to figure largely in the foreign commerce of the country. Even as late as that year the shipments to other lands aggregated but 8,867 casks spirits and 3,938 barrels rosin, while ten years later, so great had been the expansion given to the consumption of rosins in the industries of Europe the foreign shipments had grown to 92,436 barrels (500 lbs.), an indication of the tremendous development its production was to show through the subsequent decades until the culmination in foreign shipments came with the movement abroad of 1,579,656 barrels in 1901, the apex of the spirits turpentine movement coming eleven years later in foreign shipments of 416,221 casks in 1912.

TURPENTINING WITH SLAVES IN THE 30's AND 40's

PAGES FROM LIFE ON A NORTH CAROLINA PLANTATION.

(By James Battle Averit.)

[Rev. James Battle Averit was chaplain on the staff of Gen. Turner Ashby, chief of cavalry under "Stonewall" Jackson, and continued his work as a clergyman for many years after the war. He was born on the great plantation of his father in Onslow County, North Carolina, known as "Rich Lands," on the west side of the New river, near Jacksonville. Twenty thousand acres of heavily timbered land of the plantation made up the turpentine orchards. On this tract turpentine was worked for nearly a hundred years, and some of the rosin run into Catherine Lake, part of the plantation, eighty or more years ago, is now being recovered, as told in the article on "Mining for Rosin." In his old age Mr. Averit wrote an interesting book on "The Old Plantation; How We Lived in the Great House and Cabin Before the war." The following is a chapter telling of the turpentine operations.]

AS WE are about to enter on the description of the forest wealth of this estate—the turpentine orchards of the plantation, on which was expended the larger part of the labor and from which the revenue was mainly derived—it will be well if we pause just long enough here to make the full acquaintance of Uncle Philip, the manager of this department. In many respects, he was the most remarkable person of his class the writer has ever known. He was now about sixty years of age, of small stature, a genuine blue-black, as active as a boy of seventeen, and as quick in his motions as the beautiful horse Selim, which he rode. This animal was the joy and pride of the old man's heart, and ranked next in the old African's affection to his old master, for whom he bore a love which was the outcome of a close relation running thru their lives. Philip had come down with the plantation from the planter's father. In childhood and boyhood, and in fact thus far in life, they had really been boon companions, together learning to swim, to ride, to handle firearms, and thus learning to know and trust each other in a way and to a degree that few persons, if any, thinking of the institution of which their close relation was the product, can at this late day understand.

To both Fred Douglas and Booker Washington, in point of advantage given them by education, this noble old servant must necessarily have yielded: but he was very little, if any, inferior to any man, white or colored, the writer has ever known, in all that is understood by keen active mother wit and strong common (or rather uncommon) sense. Outside of his small family there was no one whom the old planter loved more tenderly or trusted more implicitly. Thoroly illiterate, really not knowing a letter in the book, he was fully equal to all the details of his large and important trust. His memory, naturally strong and tenacious, by constant use and honest trust in it, served him instead of a memoranda, and his verbal report of the week's work which went on the plantation books regularly every Saturday afternoon, was both full and accurate. Without him the proprietor would have been sadly at sea, in his full knowledge of all connected with his department.

What was very remarkable in his case was that, in his full fidelity to his master, he did not compromise the respect and good will of his fellow servants. Among his own race he was the most universally popular servant on the whole estate, and had there been set up here a little Dominion of Dahomey, Uncle Philip would have been chosen king by universal acclaim. One can quite understand why such a servant should have been very much petted, but no indulgence seemed to spoil him. Do you see yonder house standing at the close of what the servants call Broadway, in that cluster of elm and maple trees? That is Uncle Philip's house. Let us enter it. In the first room you find shelves and hooks and racks around the walls. What do they mean? This is the old man's little storeroom. He was so absorbed in his devotion to his master's interests, so fully cut off thereby from the many little ways of making money for himself accorded other servants, that he was allowed the privilege of his little store, where he kept a slender stock of staple goods—coffee, tea, sugar, cheese, cakes, peanuts, clico, and home brewed beer (ginger and persimmon), with which he drove his little trades with his fellow servants; in lieu of money, often taking coon, rabbit and squirrel skins as a circulating medium.

One would have been surprised to have known how much money the old man took in the course of a year. The writer when a boy would often exceed the allowance of pocket money from his mother. On the Southern plantation the rule was that the sons drew their pocket change from their mother until they were sent off to school, when the father became the son's banker. Often and ever, when out of money, the writer would borrow from Uncle Philip, who always insisted on a note given with a formal seal, at ninety or one hundred and twenty days after the date. Remember, the old man did not know the boyish handwriting from Egyptian hieroglyphics. It was a matter of trust, pure and simple. Invariably a few days before the note fell due the old man would approach the maker of the note with the most respectful suggestion: "Marse Jeems, you done forget dat little paper of yourn, isn't you?"

Unless the writer wished his father to know of this transaction he had to stir around, get up the money and settle with his devoted old creditor, who insisted on payment of principal and interest, but who would immediately renew the loan if desired. It has always been a matter of mystery to me how he could figure up his interest so accurately, and yet I never knew him to make a mistake. This incident is here given that one may see the generous confidnce and loving relation of the old plantation life between master and servant. If the writer meets with Mrs. Stowe in the next world he intends to acquaint her with much that did not appear in her ignorant compend of anger, hatred, and malice—that avant-Coureur of the John Brown raid which was the skirmish line of 1861 and '65—that period of national dementia which, in its bitter and bloody antagonism to the law and order both of Holy Scripture and the Constitution, argued that prolongation of the godless French revolution.

We shall now go on to the lake and acquaint the reader with the turpentine orchards and the distilleries of the spirits of turpentine and resin connected with this estate. Catherine Lake was the largest of a chain of seven or eight small lakes which we find in the midst of twenty-two thousand acres of splendid pine trees embracing the turpentine orchards of this estate. This lake was about a half mile in length and from a quarter to three-eighths of a mile in breadth, in many places quite deep and in some places covered with pads of water lilies, in season very beautiful with their large white flowers. There was neither visible outlet nor inlet. It must have derived its bountiful and uniform supply of crystal water from hidden springs. It contained a large supply of small fish of the perch family, with a great many small turtles, or as the negroes called them, "tarapins." In the winter large droves of wild ducks

came from the rice fields or elsewhere to roost here. Come, get into this little sail boat and from yonder little island we will get a full view of the old planter's possessions on the south bank of this lake, and we will have a long, long talk about this branch of the plantation industries.

Those large columns of black smoke you see issuing from those tall chimneys are from the two large distilleries you observe there, while that windmill drives the force pump which furnishes the large quantities of water required in the distillation of some hundreds of barrels of crude turpentine consumed daily. The process of distillation of spirits of turpentine for the world's markets is so like that of whiskey and brandy that we do not regard it necessary to go into details. In that large cluster of houses nearby you will find the cooper shops and the large sheds for storing the barrel timber. Do you hear that merry ringing out of voices, in tuneful time to the coopers' adzes and drivers as they force the hoops home on these barrels used in the shipment of the white resin to New York and Boston? From each cooper were required forty-two barrels each week, and so easy was the task and so skilled were the best of them that they could readily enough make over and above their task from eight to ten barrels per week extra. Thus Dave and Sam and the other coopers had from eighty cents to a dollar in change to spend at Uncle Philip's store or to do what they pleased with on Saturday afternoons. Near by is the glue house, where the casks used in the shipment of spirits of turpentine were made good and tight; and there is the large and airy stabling for the numerous mules used in the heavy transportation of the crude turpentine to the distilleries, as well as in the hauling of the manufactured article to the landing on the river some six miles away.

That comfortable looking home out there to the left is the summer house of the old planter, far away (some three miles) from the malaria that may be lurking around and the mosquitos buzzing about the old mansion of the plantation proper.

An elaborate description of the coastal forest region of the South will not be here attempted. Suffice it to say that in the large area of the western part of the State of North Carolina, together with Piedmont and coastal region, are embraced more than three-fourths of the acreage of the entire State. The revenue in timber, lumber and turpentine products has been variously estimated at from thirty-five to forty millions each year. Into these twenty thousand and more acres connected with this estate which we are describing let us at once enter with Uncle Philip, and we will listen while the writer is describing the mode by which these millions on millions of boxes are inserted into these large yellow pines, out of which the crude turpentine is taken to go into these distilleries for the world's market. The planter's New York market is largely regulated by the relation of supply and demand in the Liverpool and other European markets.

When you are about to take up a body of pine forests and reduce it to the culture of turpentine, what is the first thing to do?

"Listen, Uncle Philip, and see if I inform the reader correctly."

"Yas, suh, dat I will, Marse Jeems."

Well, the first thing you do is to burn over the woods, so as to throw them open by destroying all the undergrowth possible. Then the box cutters come some twenty-five or thirty in number. In the late fall and all thru the winter, when the sap is flowing more sluggishly, and when the cutting into the trees seems to injure them least, they are very busy. These splendid axemen come with their long, narrow bladed, highly tempered axes, which are made by the blacksmith, Robert, on the plantation. They make seven or eight deep incisions in the shape of a crescent or new moon, about five inches above the ground, obliquely down into the tree. Then they hollow out behind these incisions towards the heart of the tree, and presently you will see how skillfully these axemen with their ringing strokes will complete one of these smoothly finished pockets or boxes as they are called.

Then they corner them as they call it; that is they will smoothly notch these pockets at the corners, so as to cause the flow of the sap from the edges towards the center. How many of these boxes will they insert into each tree? Some four or five. This depends on the size of the tree. You must be careful not to overbox the tree—in failing to leave a space as broad or broader than a man's hand of untouched bark between the boxes—so that the sap will have plenty of room for free and rapid flow. What is the estimated capacity of the box? About a quart or a little over is the regulation size. How many of these in a day's task for each man? A good axeman will readily cut one hundred and twenty-five daily, will have finished his seven hundred and fifty by the middle of the afternoon on Friday, and have the remaining part of the week for himself. Thus your thirty hands will have finished in one week twenty-two thousand, five hundred? Yes.

How many of these constitute a week's task for a good hand? Twelve thousand, five hundred are accounted a fair work for an average man to chip, or open the pores of each box once a week. What do you mean by chipping? Each man is furnished with a tool called a round-shave, which is of finely tempered steel in the shape of a small knife, round and bent like your forefingers curved from the second joint, about an inch and a half in width, with a shank about seven inches in length to fit in a wooden handle. With this sharp instrument he scores horizontally just above the box or pocket and thus keeps the pores open and the sap running freely into the box. If the winter is an open or warm one the insertion of the box will have set the pine to bleeding so freely that the box will become full by the tenth of April. If so, another set of hands come with their dippers and buckets, dip out the boxes and fill their buckets, which they empty into barrels dropped here and there at convenient places, by negro boys with their mule carts. These the carters bunch or gather together, so as to expedite the work of the wagons hauling them to the distilleries, after they have been headed up by a cooper.

Thus the work of chipping goes on without interruption each week, from about the fifteenth of April until the fifteenth of September—about five months—while the dippers go from one task to another, and so regularly thru the working season of five months. Each one of these dippers will dip out and fill four barrels daily, or twenty-four in a week. He will get thru with his task on Friday; and on Saturday, by pushing on with his work, he will make forty to sixty cents for himself. You will observe that by this plan of operation each crop will be reached by the dippers some four times each season, giving the planter from his orchard as many partial harvests each year, which to one understanding the judicious use of money is a marked advantage over the cotton, sugar, tobacco or rice crops. When the nights begin to turn cool and the sap ceases to flow you will find that on the face of the tree (the space between the chipping or the opening of the pores and the pocket or box) there will be a deposit of turpentine not unlike the whitest wax. This is the turpentine which has been hardened by the air. Into a box on four short legs at the base of the tree this deposit is scraped off and mixed with the contents of the pocket, and finds its way to the distilleries.

This closes the active operations of the year, which generally comes about the first of November, when these laborers can be taken to work on the plantation, opening ditches, clearing new ground or put to cutting other boxes in the virgin pines, if the planter wishes to extend his crop of boxes each year. The average chipper from his crop in five months will produce about five hundred barrels of about thirty-two gallons each, so that the sixty servants will in that time make about thirty thousand barrels, leaving some six months of the year to be employed, either in the extension of the turpentine orchard or in farm work, as the planter may elect. By joining these two industries, the orchards and the plantation, making the latter the full feeder of the former, you will readily understand how it is that the planta-

tion can be kept with its fine fencing, trim hedgerows, well worked roads, largely like a garden.

How long will the average pine tree continue to yield its sap as described above? A crop of boxes will continue profitable for ten or twelve years. Is the tree worthless after that time? No, it yields fine wood, excellent lumber, but not the best—as largely drained of its essential oil in the turpentine extracted it cannot be as valuable for timber purposes as the untapped tree—yet in the markets of this country and Europe still valuable; notably so when not exposed to the weather but used for inside work, as in framing, flooring and ceiling. Then, too, many of these pines, after they have been cultivated for years, are cut out and from them are extracted the tar and pitch of the markets of the world. Do you regard these turpentine orchards, worked as indicated above, as profitable? One would think so if one would look at the accounts of the planter with his commission merchants in New York. You will see that his income is about $60,000.00 per annum, without reference to the yearly increased value of stock, lands and servants, which are by no means inconsiderable items or features of this steadily increasing wealth of the planter. Are the servants of the turpentine orchards generally healthy? There are no laborers in the world more so. The balsamic properties which the pine trees are constantly distilling into the air, seem to counteract any poison from malaria. What water do they drink? Here and there are small, but clear streams of running water all over these large tracts of pine covered lands, and if the servant is out of condition, you will see him take the joint of the ordinary reed, which he carries in his pocket for that purpose, kneel down at the base of a pine tree and slake his thirst from the rain water which has been caught in the box or pocket, impregnated as it is with the turpentine. This reaches and regulates his liver and keeps him healthy.

As compared with the other staples of the South, what do you regard as the most serious drawback or disadvantage of the planter's turpentine interests? The laborers, and notably so the chippers, are employed in large wooded tracts of country, out of range of anything like close oversight and must be stimulated to their best work, as well by premiums for best crops as by so regulating their work that a portion of each week is their own to do as they please with. It is very different on the cotton, sugar, tobacco or rice plantations. The great disadvantage in the crop, however, is that the distilleries, the spirits of turpentine, the resin and in fine the whole plant and its yields, are so combustible that no insurance company, domestic or foreign, will insure the property. The only protection against fire that can be had is to police the premises as thoroly as possible. How is this done? By placing here and there all over the orchards double log cabins for the families of some twenty or more white men. These people occupy these cabins free of rent, with as much land as they choose to cultivate, which rarely extends beyond a garden and a truck patch, the men fishing and hunting by day and night, the women hoe the little crops and raise poultry, the children gathering whortleberries and wild currants. These men are required to do three things: first, they are to guard the orchards from fire, and if a small fire occur, as it often does in the summer time by lightning striking and igniting a resinous pine tree, they and their families must extinguish it. If it gets beyond their control they are to blow horns, summoning the neighboring tenants, sending all around for help, fight the fire until it is put out; secondly, they must once a week salt and care for the herd of cattle and drove of sheep belonging to the proprietor, carefully penning the sheep at night so as to protect them from the dogs, wildcats and bears, which are found in those large tracts of unbroken forests. Thirdly, they must look out for the planter's honeybees, and when the cold weather sets in they must take the honey and carry it into the mansion for the use of the planter's family. They are obliged, under contract, to turn out when summoned to work the roads of the estate. These tenants find a ready market for all the game, poultry and berries they will carry into the plantation. Sometimes they spend a whole lifetime in this dwarfed but important relation to the proprietor. They form a distinct element in the organism of this large landed estate. They never mingle with more thrifty white people, while the negroes on the estate look down on them, calling them, most disdainfully, "poor white trash." Under the old regime this was the people who were unhappily affected by the plantation system, because they lived in the prsence of and in close contact with servile labor and lived and died with an emphatic protest against the decree which forced them to work. From this class all thru the coastal region, during the late Confederacy, sprang what was called the "buffalo" who cast in their lot with the federal troops as soon as any lodgment was made. They have not yet died out from among us but still live, utterly contemned by the better class of whites and distrusted by negroes.

"Well, Uncle Philip, how does this account agree with your view of it?"

"It's mi'ty nigh rite, Marse Jeems; youse made it mi'ty plain to dis old darky."

"Well, what does that heavy smoke mean over there, old man?"

"Why, suh, Harry, the distiller, is letting off his heavy charge of rosun and dat is de smoke you see, suh. Marse Jeems, it's 'bout twelve o'clock, suh, and I must be gwining."

So to the mainland we go, and when about half way, where the water is quite deep, and we see the tall bodies of the large pines standing all around the rim of the lake, not unlike the palisades on the Hudson river, Uncle Philip takes a long tin bugle and giving a full blast upon it wakes up the echoes far and near, which come back to us in wave sounds very deep and at times very sweet. Reaching the shore, the writer goes around to a secluded cove and, in the crystal waters of the lake, enjoys a delightful bath with a long swim, after an old-fashioned dive from the springboard with which this deep pool is furnished. After the bath he is joined by the old planter at lunch, where some of the lake fish are discussed, together with a cup of Maria's best coffee and the eggs, fried to a turn on both sides, followed by a plate of wild currants and cream. Just such a lunch for all the world as would make a Southern man's mouth water, even if he were at Harvey's in Washington or Delmonico's in New York.

USES OF ROSIN AND TURPENTINE IN OLD PLANTATION DAYS

THE LONG LEAFED PINE ONE OF GOD'S GREAT GIFTS TO MAN.

(By Francis Peyre Porcher, Surgeon P. A. Confederate States, in "Resources of Southern Fields and Forests," Richmond, Va., 1863)

THE spirit turpentine of the Pinus Australis (long-leaf pine) is a well known and valuable diffusible stimulant, diuretic and anthelmintic, in large doses acting as a laxative. It is from this species that the Boston turpentine is obtained, which enters into the composition of soap of a very superior quality. This tree is, indeed, one of the great gifts of God to man.

The forests of pine are not only useful but beautiful. The characteristic moan of the winds through their branches, their funereal aspect, almost limitless extent, and the health-giving influences which attend their presence all contribute to make the pine an object of peculiar interest to the people of the Southern States. The terebenthieate odor of the tree, some electrical influence of its long spear-like leaves, a certain modification of ozone (an allotropic condition of oxygen see Faraday's examinations), are severally esteemed to modify the atmosphere and diminish the effects of malaria. They also create a mechanical barrier to the ingress of malaria and hence the pineland residences, though contemned for their sterile aspect, have proved a blessing to the Southern planters as affording a comparatively safe refuge from the unhealthy emanations of the neighboring plantations. The seeds of the long-leaf pine are edible and nutritious and are largely consumed by hogs.

I need not describe the process for making tar. It is a very compound substance and contains modified resin, oil of turpentine, empyreumatic oil, acetic acid, charcoal and water, and when inspissated by boiling is converted into pitch. I will add what Wilson states of its economical employment as it may be of great service on our plantations and in veterinary medicines. It serves well as a paint to coarse kinds of boarding and paling, but is improved in its use by the addition of tallow or other coarse fat. It is applied as a covering to cuts on animals, and to parts affected by the fly. It serves, either alone, or in combination with some fatty substance, to defend the sore or diseased feet of cattle from being further injured by wet or abrasion. When spread upon coarse cloth it is a prime covering for broken horns and makes an excellent application to various kinds of wounds and punctures in cattle. It is given internally to horses as a remedy for cough, also as a delugent and local remedy for scaly and eruptive diseases. It is used to cover the lower surface of posts to prevent their rotting, and grain soaked in it is not eaten by birds. Tar water was formerly much used in medicine, but at present wood naphtha and pyroligneous acid are more commonly employed.

The buds of the pine or the inside bark steeped in water is a favorite domestic remedy on our plantations for colds and coughs. Bits of fat pine steeped in gin are also used. A decoction of the inside bark is given daily as a remedy in chronic diarrhoea. Pills of rosin are often employed as a simple diuretic. Rosin also enters into the composition of strengthening plasters. A preparation with rosin to preserve leather and shoes is recommended by Col. Macerone in the Mechanics' Magazine, 1848.

Lampblack is obtained by the turpentine manufacturers from the combustion of the refuse of their operations in furnaces appropriate to that purpose. The smoke deposits itself on the sacking which is hung up. It is swept off and sold for common use without further preparation. The lampblack in this state contains some oil, which is separated by being heated to redness in a close vessel. This may be easily made in our large turpentine distilleries throughout the Confederate States.

Charcoal from the pine is employed as a tooth powder and to purify tainted meat. It forms a part of all reducing fluxes. It is the basis of most black paints and varnishes. It is used in farriery in conjunction with linseed meal as an antiseptic cataplasm for cracked heels and foul and fetid ulcers.

Whenever either wine, vinegar or other fluid is to be clarified it is simply to be mixed with the liquor; a froth appears at the surface and after infiltration it is pure and colorless. Charcoal is also used as a valuable manure. Charcoal and sand placed in the bottom of a barrel or hogshead will purify water passing through it. It is generally believed that charcoal will prevent contagion, yellow fever, etc., if taken during the prevalence of an epidemic. It is also used as a mild, mechanical laxative in dyspepsia with foul stomach.

Creosote, also a product of the pine, is obtained from the crude pyroligneous acid and heavy portion of the oil of wood tar, sometimes called the essence of tar, and used in the preservation of meat, the flavoring of hams and as a remedial agent for its constringing effect. It coagulates albumen. Fresh meat suspended over creosote will be preserved.

Vinegar and acetic acid, obtained from pyroligneous acid, is purified by converting it into acetate of soda and decomposing that salt by means of sulphuric acid. The acetic acid, after being distilled, is lowered by water, colored, and used as vinegar.

Turpentine is now one of the most uniformly employed of remedial agents. It is quite surprising to how great a diversity of conditions it is applicable. All these depend, however, upon its natural properties. As an external rube-

facient, a stimulant, an astringent, a stimulating diuretic and laxative, it admits of frequent application. To burn turpentine in lamps it only requires purification by re-distillation and a burner which will give increased oxygen for the consumption of the large amount of carbon which it contains.

Turpentine is one of the best means of chasing away fleas, whether from place or animal and a bed of very fine shavings of some wood which abounds in turpentine is one of the easiest and most effective means of banishing them from dogs. Wilson states that the oil of turpentine is almost a specific for spasm in the bowels of the horse.

Turpentine and rosins are both abundantly within our limits. An excellent English mixture to render leather water-proof is made of turpentine. In the present scarcity of leather and exposure of our soldiers I think its introduction not inappropriate. It is used by the punt shooters in the fenny parts of England. Melt together in an earthen pipkin half a pound of tallow, four ounces of hog's lard, two ounces of turpentine, and as much beeswax. Make the boot thoroughly dry and warm and rub in the mixture well with a little tow as hot as the hand can bear, or else hold the leather over a very gentle fire till it has thoroughly imbibed the mixture. Another mixture for the same purpose is made thus: Burgundy pitch (rosin?) and turpentine, each two ounces; tallow, four ounces, or half a pound of beeswax, a quarter of a pound of rosin, and a quarter of a pound of beef suet. The leather must be dry and the mixture warm.

To make cloth waterproof with turpentine for the use of negroes in picking cotton when the weed is wet from rains or dews, and also for tents, the following method is adopted: To every gallon of spirits of turpentine put two and a half pounds of beeswax, boil well in a pot, remove the fire, and while it is hot put in the goods. Move it about until well saturated, then hang it up to dry. It will require one gallon of turpentine to every eight yards of goods. It is more pliant than India rubber.

Candles for war time are made from rosin. A model economical candle six.y yards long, for use of soldiers in camp which will burn six hours each night for six months, and all that light at a cost of a few cents, is made as follows: Take one pound of beeswax and three-quarters of a pound of rosin, melt them together, then take about four threads o fslack, twisted cotton for a wick, and draw it about three times through the melted wax and rosin, and wind it in a ball, pull the end of it and you have a good candle.

A preparation of turpentine, probably turpentine redistilled, called Terebene, is manufactured at Camden, S. C., and largely used as a burning fluid since the blockade. The price is moderate. It gives a good light, but requires a modification of the old kerosene chimney. Palmetto oil, so called, is probably pure turpentine. Prof. F. A. Porcher has used and recommends turpentine and I have known others who have employed it for months as a burning fluid. It is not explosive. In using these highly carbonaceous agents an abundance of air must be admitted to the wick to consume the excess of carbon, which would otherwise be thrown off as smoke or deposited as lampblack. Lampblack is made from the imperfect destruction of turpentine in large burners with suitable apparatus to collect it. It may be made in the Confederate States with profit. (See footnote.)

An economical soap without grease is made from rosin. To four gallons of strong lye add ten pounds of distilled rosin or eight pounds of pure gum not distilled and free from trash; boil steadily until there is no rosin to be seen and if the quantity of lye is not sufficient add more and continue to add until the rosin disappears, boiling until it makes a brown, jelly soap. This soap has been extensively made in St. John's Parish, South Carolina, during the past year (1862) and is stated to be equal to the best soap made with grease. In making tallow candles stick the wicks in a little spirits of turpentine which will make them burn brighter.

Decoction of the leaves of the pine tree sweetened to be freely drunk warm, when going to bed at night, or cold during the day, is very much used as a domestic remedy for colds and coughs.

In 1840 gas lighting had not been dreamed of. Kerosene was then totally unknown. Camphine, a refined preparation of spirits turpentine, was a recent and a most decided improvement on the lamp oil or tallow dipped candles. This article, camphine, came into almost universal use, having a very high illuminating power, though exceedingly inflammable and so extremely dangerous. Its cheapness was a great recommendation, and its only rival, if it was a rival for illuminating purposes, was sperm candles, which were beyond the reach of those in moderate circumstances. Somewhat later on admantine candles, because of good lighting power with little accompanying hazard, in a great measure displaced camphine.—Reminiscenses of John McLaurin, of Wilmington, N. C.

PAGES FROM WILMINGTON'S STORY AS AMERICA'S FIRST GREAT NAVAL STORES PORT

(By Thomas Gamble.)

TO TELL in detail the story of Wilmington as a naval stores market would be in a large measure to repeat the history given elsewhere of the naval stores industry and trade of North Carolina. While tar and pitch and crude turpentine found an outlet through Bath and Newbern before Wilmington became a port where they were handled, to Wilmington speedily feel the position of chief market for all of such commodities. Settled in 1730, it was but a short time until the products of the back country began to find a way to the Northern markets in increasing quantities through this new port. Among the places specified as points of inspection Wilmington is found in the early laws of the Province and its growing importance is soon shown by the designation of two inspectors for it, while elsewhere one such official was deemed adequate for the work.

Then in 1766 an act was passed by the General Assembly for the appointment of an additional inspector for the "great island opposite Wilmington, known by the name of Eagle's Island," the Inferior Court being required each year to appoint a fit and proper person, such inspector to receive the same fees as other inspectors of naval stores. It is interesting to note that Eagle's Island has since then never been without its direct connection with the naval stores trade and today a distillery and storage and shipping facilities carry on the unbroken naval stores history of the island from 1750 to 1920.

Before the Revolutionary war checked the expansion of the industry and put a temporary stop to shipments the bulk of the production of the Province was passing through Wilmington. Its trade was quickly recovered with peace and by the opening of the next century (1800) it had won a position, long retained, as one of the largest shipping points in the world for turpentine and tar. In 1804, of crude turpentine alone, 77,000 barrels are stated to have been handled here. Gradually, as Ashe points out, the naval stores industry declined in the northeastern counties and was concentrated in those of the southeast. Writing of the trade of Wilmington in 1815, Jochua Potts said: "In the lower part of the country transportation of lumber, naval stores, timber and spars is facilitated by rafts, conducted by a few hands down numerous creeks and rivers. In times of uninterrupted commerce many ships and vessels of considerable burthen were annually loaded here and bound for European ports with cargoes of naval stores, tobacco, flaxseed, cotton, rice and large timber of pitch pine. Their cargoes were dunnaged and stowed with staves.

"Tar is not now (1815) made in as large quantity as formerly nor is it produced and brought to market with the same ease. It is an article subject to waste, and the price generally low. Countrymen, in many instances, have paid attention to cotton and timber, and numerous inhabitants of that description have removed to the Western States. Since the return of peace, however, the demand for tar and turpentine has raised the value of these articles to an encouraging price. They are rafted to Wilmington and after having been coopered and inspected are transported coastwise, and a proportion shipped to European ports.

"Turpentine is seen at market from June to December. In consequence of the late war (with Great Britain) the quantity has been reduced and prices depressed. The present demand has enhanced its value. There is scarcity at present.

"It is inadvisable and often disadvantageous for a merchant in a distant State or foreign port to dispatch a ship to Wilmington under orders for a cargo of our produce without having written his correspondent of particulars required. Four to six weeks previous notice to the agent is always requisite that he may have time and opportunity to procure the produce described to the best advantage and have it in readiness by the time of arrival of such ship. Great detention and disappointment often happen in consequence of voyages being abruptly commenced, as but seldom peculiar kinds of produce can be had on sudden notice. Inspection of produce is established by law throughout North Carolina. A clause enacts that the shippers thereof shall pay the fee of inspection on the several articles, including tar, turpentine, pitch and rosin. The rates are low."

As the forests of the coastal region, naturally the first to be exploited, approached exhaustion, the industry moved inland. Wilmington, where distilleries were established in the 30's, if not sooner, found rivals in that respect at interior points. By 1844 it is chronicled that Fayetteville had a turpentine distillery to which was shipped the crude produced in Harnett, Cumberland, Chatham and Moore counties. But Wilmington drew its shipments of naval stores from an ever broadening radius. Telling of the conditions of transportation and trade in 1842 Robert W. Brown said:

"Portable articles of produce are brought from the interior country by land carriage to Fayetteville, at the head of boating navigation, thence they are carried to Wilmington by well constructed steamboats and their numerout towboats, comprising a flotilla on an extensive scale, qualified to carry large quantities of merchandise up and produce down, and when the river is not too low for steamboats to run all the way greater dispatch is not given in any part of our country. At those periods of low water which occasionally happen, transportation is facilitated by the smaller flat towboats, aided by steamboats as far as the latter can proceed."

Regular packets were then plying between Wilmington and New York and

EAGLE'S ISLAND, OPPOSITE WILMINGTON, N. C.
WHERE NAVAL STORES HAVE BEEN HANDLED FOR ONE HUNDRED AND SEVENTY YEARS

Philadelphia and on each voyage moved considerable quantities of naval stores to those Northern ports. A new route to the interior had also been established in the Wilmington and Raleigh railroad. Telling further of naval stores conditions in his day, Mr. Brown continued: "Tar is rafted to Wilmington down rivers and creeks, and bought of the country people by the raft, from 20 to 300 barrels, afloat; after which it is landed on the wharf, inspected and coopered, the purchaser always paying inspection of 2 cents per barrel, cooperage, wharfage and landing charges, the whole expense about 12 cents per barrel, including one week's wharfage. Our coopering is good, and attention is paid to pumping, in order to clear it of water as much as possible. January to May is the season when tar is most plentiful. Turpentine is seen in market from June to April. We generally get the greatest quantities from the 20th of November until about the last of February. Before and after these periods it comes in smaller parcels. After heavy rains and during high freshets we have considerable quantities down at once, and often at such times the supply offered for sale reduces the price. Turpentine is rafted down and sold subject to inspection and like expenses as tar. The buyer, from custom, pays for the whole raft as landed, including hard or scrapings as well as soft; the hard, however, at less price—one-half the rate paid for soft. By custom and law of the State it is weighed, taking 320 lbs. gross as the barrel. Our barrels are generally large and when packed overgo that weight. The usual crop has been 100,000 to 140,000 barrels. I will further add, in regard to this article, that on inspection, after the inspector has tried each cask at the bung with a rod, he weighs a small portion of the lot, by which the whole purchase is averaged. Inspection is 3 cents a barrel. The crop of 1843-44 is expected to reach 200,000 barrels. The railroad route delivers a large proportion of turpentine to market, which is in addition to the rafting process. The several distilleries now established for working up turpentine in the home market consume weekly 1,500 barrels of the raw material, and such distilling has become a great item of business here. They produce rosin, spirits turpentine, and make varnish and pitch."

A decade later Wilmington had a trade in naval stores for the twelve months, December-November, 1851-52, aggregating 537,345 barrels, valued at $2,650,931, and divided as follows: Foreign exports, turpentine 33,596 barrels, valued at $117,600; coastwise exports, spirits turpentine, 96,277 barrels, $1,-707,999; rosin, 320,219 barrels, $560,383; tar, 17,522 barrels, $35,044; pitch, 6,660 barrels, $9,157; raw turpentine, 63,071 barrels, $220,748. Heavy as this movement was, it was to be greatly exceeded in after years. Twenty-five years later Wilmington handled close to the million packages.

Considering the cheapness of the timber, the low cost of the other elements of production, the prices received for naval stores in that period, seventy-odd years ago, were fully as profitable as much higher prices seen in recent years. In September, 1846, for instance, spirits brought 37 cents a gallon, and tar $1.60 a barrel, and in December, 1848, spirits 28 cents, rosin 85 cents a barrel, tar $1.30, soft dip $2.25, hard $1.25. Those were the days of the much vaunted "dollar of our daddies," and such prices were infinitely better in purchasing power than those paid at the supreme height of naval stores production twenty-odd years ago when spirits turpentine dropped to 22 cents a gallon at Savannah and the lowest grades of rosin brought less than $1.00 per 280 pounds.

For over a half century the bulk of the movement of naval stores from North Carolina to the North was by means of schooners, none too clean, none too fast, a slow, reasonably sure, and cheap means of carriage, which continued to handle such commodities until many years after the civil war. Joseph Jefferson, in his autobiography, tells of these vessels in an amusing incident:

"In the fall of 1852 we resolved to make another trial of our fortunes in the Southern circuit. Our limited means compelled us to adopt the most economical mode of transportation for the company. It was settled, therefore, that we, the managers, should arrive at least a week in advance of the opening season. Our passage must be by rail while the company were to proceed by sea. There was in those days a line of schooners that plied between Wilmington, N. C., and New York. The articles of transportation from the South consisted mainly of yellow pine, tar and resin, which cargo was denominated naval stores. Feeling confident that we could procure passage for our company by contracting with one of these vessels to take them to Wilmington we determined to conclude a bargain with the owners. The day was fixed for their departure, and Mr. Ellsler and I went down to the wharf at Peck Slip to see them off. It was an ill-shaped hulk, with two great, badly repaired sails flapping against her clumsy and foreboding masts. The deck and sides were smeared with the sticky remnants of her last importation, so that when our leading actor, who had been seated on the taffrail, arose to greet his managers, he was unavoidably detained. There was handsome John Crocher, our juvenile actor, leaning with folded arms and a rueful face, against an adhesive mast; Mrs. Ray, the first old woman, with an umbrella in one hand, and a late dramatic paper in the other, sitting on a coil of rope and unconsciously ruining her best black dress, etc., etc. It was a doleful picture. Our second comedian, who was the reverse of being droll on the stage but who now and then ventured on a grim joke off it with better success, told me in confidence that they had all been lamenting 'their ill-tarred fate.' As we watched the wretched old craft being towed away to sea, we concluded that we should never forgive

ourselves if our comrades were never heard of again. Within a week, however, they arrived, looking jaded and miserable."

For the half a century before the war broke out in 1861 Wilmington's position as the leading naval stores port of the South was unquestioned. No one probably conceived that it would ever be lost. In 1860 its supremacy was absolute. Cheap transportation was furnished by the sailing vessels to New York. Under deck rates were: Turpentine and tar 35 to 45 cents a barrel, rosin 30 to 40 cents, spirits turpentine 50 to 60 cents. In December of that year yellow dip was quoted at $1.75, virgin $1.40, new hard 90 cents, spirits turpentine 31 cents a gallon, common rosin 70 to 80 cents per 310 lbs., No. 2, 90 to 95 cents, fine rosin $1.25, tar $1.55. The lowering clouds of sectional strife created such conditions that nothing seemed saleable except at a sacrifice of values. Commerce soon practically ceased and the production of such commodities, as during the Revolution and the War of 1812, quickly shrunk to comparatively meagre proportions. In February, 1862, spirits turpentine was quoted at Fayetteville at 20 to 21 cents. Confederate money had not at that time largely lost its buying power. In November of the following year, though, at Wilmington spirits was quoted at $4 to $4.50 a gallon, and at Fayetteville at $1.50 to $2 a gallon. With the close of the war and the reopening of trade the markets soon became fairly stabilized, with prices, as a result of the scarcity produced by the war, ruling temporarily high. The following statement fairly well shows the drift of prices at this time and in the later years of heavy production:

	Sept. 1865	July 1866	Dec. 1867	Sept. 1868
Spirits Turp.	$ .65	$ .44	$ .47½	$ .39½
Strained No. 2	4.35	2.00@ 2.50	1.90	1.80@ 2
Pales	....	3.75@ 5.25	....	4.25
Virgin dip	3.50	4.05	2.90	2.70
Hard	....	1.52½	1.70	1.60
Tar	5.50	....	1.95@2	2.60

	Sept. 1870	April 1872	Aug. 1877	April 1884
Spirits Turp.	$ .35½	$ .57	.31½	.29½
Strained No. 2	2.25	3.00	1.50	1.20
Pales	3.25	5.75@6	2.50	....
Virgin dip	2.35	5.65	2.15	2.00
Hard	1.35	2.90	....	1.25
Tar	1.50	2.75	2.15	1.15

Tar per bbl. 280 lbs.

Steamships competed more actively with the sailers after the war, and the rates, except as to spirits turpentine, seem to have been generally about the same on both classes of vessels. In September, 1870, for instance, the following freight quotations are found per barrel, Wilmington to New York:

	Steam.	Sail.
Crude	$ .40	$ .40
Tar	.40	.40@ .45
Spirits Turp.	1.00	.60
Rosin	.35@ .40	.35@ .40

Nearly thirty firms are found at this time receiving naval stores, some in a very large way. European connections had been quickly re-established and full cargoes were being exported to various countries. Dr. James Sprunt, in his "Chronicles of the Cape Fear River," in telling of the resumption of business, says:

"After the four years of war (1861-65) the trade and commerce of the Cape Fear river gradually returned to normal conditions. At first there was a large coastwise trade by sailing vessels, chiefly schooners of 150 to 600 tons, and a larger volume of business direct with Europe and the West Indies. The exports were naval stores—spirits turpentine, rosin, tar—and some cotton to Europe and lumber to the West Indies. For many years after the war Wilmington maintained the first place in the turpentine and lumber trade, and there were as many as a hundred sailing vessels in port at one time."

It was not until 1881 that the square rigged vessels in the foreign commerce felt the competition of the steamers that were eventually to drive them from the naval stores trade. Dr. Sprunt tells of the new era of steam in the arrival in that year at Wilmington of the British steamship Barnesmore, chartered by Alexander Sprunt & Son, which loaded a cargo of 3,458 bales of cotton, 673 casks of spirits turpentine and 550 barrels of rosin. "Much ado," he says, "was made of this occasion and a banquet and speech making accentuated its importance to the community." The sailers gradually succumbed to the more satisfactory transportation offered by the "tramps," and a quarter of a century later had practically disappeared as naval stores carriers until the World War brought them once more into the trade temporarily.

In 1872 the Chamber of Commerce prepared a statement on the trade of Wilmington, setting forth that the port "being headquarters for spirits turpentine, rosin, pitch, tar, lumber and timber, it was enabled to furnish the European markets with these products on the best terms and to receive cargoes in return of their products and manufactures laid down at as low cost as in any other port." "Spirits turpentine," the report continued, "is manufactured to a considerable extent in the city, and the whole pine region of this state and South Carolina is dotted with the numerous distilleries worked by owners or tenants of the forests. Most of the products find their way to this market."

WEIGHING ROSIN AT EAGLE'S ISLAND

LOADING LIGHTER WITH PINE OIL AT EAGLE'S ISLAND

Exports of naval stores for the past year from the port were given as follows:

Barrels.	Coastwise.	Foreign.
Spirits turpentine	64,862	47,162
Rosin	441,341	127,100
Tar	31,993	5,874
Crude turpentine	17,126	836
Totals	555,322	180,972

This made a total number of packages shipped for the year 736,294. Stocks in port at the close of the year: Spirits turpentine, 7,299 barrels; rosin, 72,163; tar, 2,640; crude turpentine, 2,842.

"Pitch," the report stated, "is manufactured in sufficient quantity only to supply the demand and the reputation of 'Wilmington Pitch' is excelled by none. The manufacture of this article is confined to the distillers of turpentine in this city, very little being made in the country."

Five years later, for the year ending December 31, 1877, receipts at the port are given as:

Spirits turpentine	105,038
Rosin	534,246
Tar	66,898
Crude turpentine	143,455
Total barrels	849,637

These figures convey an adequate idea of the traffic handled by Wilmington in its palmy days as a naval stores emporium, a volume never equalled elsewhere save at Savannah. While some far-seeing men may have surmised the passing of the pine forests and the cutting off of the source of such wealth, they were doubtless few in number, and even they probably placed the end much further in the future than time proved it to be. The opinion of many was set forth in a report by A. R. Black (January, 1878) as regards the feasibility of the Duplin canal project. Waxing enthusiastic even to the limit of poetical effusion, he wrote:

"The pines, the stately growing pines! How shall we speak of them in terms sufficiently laudatory? They have been the mainstay of the people of all this region for over a hundred years and are still profitable. I am told that turpentine lands, worked before the Revolutionary war, still continue to yield profitable crops. By the time one growth of pines is worked off another springs up. So that for the production of turpentine the forests are not likely to be exhausted. But it is not so for mill timber:

"The towering dark old pines,
Destroyed once, their fate is sealed,
They ne'er will be replaced."

The canal enthusiast was correct in his last surmise. The towering pines have never been, and in all human likelihood, "Ne'er will be replaced" in any areas of importance. The ravages of the Carolina pine forests were greater in the fifty years following the War Between the States than in all the two centuries that preceded it. The calls of the world for spirits turpentine and rosins grew with astounding rapidity and the drains were practically all on the trees of the "Old North State." How magnificent its forest area was can be seen from the fact that it survived as an important factor in the naval stores world until the present century. Even as late as the season of 1900-01 its handlings of spirits turpentine, rosin, tar and pitch were close to 300,000 packages. In 1890 they had still been beyond the half million total. The greatest slump began with the opening of the present century. In a few years the receipts of spirits turpentine and rosins at Wilmington had been further cut in half. Each year saw them dwindling away, with tar and pitch remaining the sole reminders of the days when Wilmington dominated the naval stores world. A few years' figures of receipts tell the sad story of exhausted sources of supplies:

Year.	Casks Spts. Turp.	Bbls. Rosin.
1890	67,785	366,503
1895	46,553	205,137
1900	25,541	181,743
1903	16,511	89,667
1913	3,750	16,986

In the last few years the lots arriving have been so small that no effort has been made to continue statistics. Tar and pitch continue to be handled in large quantities, many thousands of barrels a year. Indeed, one might correctly say that Wilmington as the port and North Carolina as the producer have returned to their conditions of colonial days when these two commodities and lumber comprised their "naval stores." Wilmington tar and pitch hold an enviable reputation among consumers today and find a ready market. Many discriminating consumers insist on having them and extol their virtues. It is quite likely that they will ever remain a minor but important element in the commerce of the port and that the pines of Carolina will indefinitely continue a source of income to thousands.

The illustrations in this article are from photographs kindly furnished by Mr. Frank A. Thompson, Naval Stores dealer of Wilmington.

CHARLESTON'S STORY AS A NAVAL STORES EMPORIUM

(By Thomas Gamble.)

DESPITE the fact that for a number of years Charleston's receipts of naval stores ran into the hundreds of thousands of packages, its reign as one of the ruling ports and markets was so brief compared with the long record of Wilmington, and it was soon so completely eclipsed in public interest by the almost spectacular rise of Savannah, that today it is seldom alluded to in its relation to the naval stores industry. Its connection with the trade had been earlier than that of Wilmington—tar and pitch were handled at Charleston many years before Wilmington was settled—but the North Carolina port speedily ran ahead in the movement through it of such commodities. Wilmington's location with regard to the original sources of supplies was more advantageous in the beginning. The settlers homesteading its forests apparently turned more readily to the production of tar and pitch as a sole or partial source of income, and before the Revolution North Carolina had become more firmly fixed than South Carolina as the source from which those important articles of commerce were to be drawn.

The early impetus in production that pushed Wilmington ahead of Charleston as a naval stores market in those initial years in the history of the American industry did not lag within a century. The longleaf pine territory of North Carolina was immeasurably greater than that of South Carolina. Indeed, of all the great naval stores producing States except Texas and Louisiana, South Carolina possessed the smallest area originally of turpentine producing trees, and its forests were more quickly exhausted once the army of operators invaded them when what may be called the first great expansion in the industry came in the decade or two before the war of 1861-65. The longleaf pine belt of the State had probably been boxed before the Civil War to a greater extent in proportion to acreage than the virgin forests of North Carolina, while those of Georgia and other States to the South had practically not been touched. The industry might have been not inappropriately termed of minor importance in South Carolina at that time, despite its long history, and the market at Charleston received but indifferent consideration, Wilmington prices and Wilmington conditions being the governing factors. Tar and pitch and crude turpentine, spirits turpentine and rosins, moved through Charleston to the domestic markets of the North, as well as to the markets of Europe, but the position of naval stores as an important element in the commercial life of the port did not become firmly fixed or win general recognition until the early 70's. The demand for spirits turpentine and rosins had grown to proportions hitherto undreamed of. Producers within the State broadened their operations, and the virgin tracts of pines invited such turpentine farmers of North Carolina as had worked out their timber holdings to invade them with their negro hands. Then, as for many years later, the timber could be leased for a song or the land and the timber bought outright for what now seems a pittance, just as a decade or so later Georgia's magnificent forest lands in some sections could be purchased for $2 or $3 an acre. Some of the operators who in the 80's and early 90's located in Georgia were among those who from 1870 to 1890 cut a great swath through the pines of South Carolina, making that State a way station between their homes in the "Old North State" and the untouched forests of Georgia where they were in many instances to permanently locate and win fortunes.

South Carolina's production of naval stores was quickly swollen to an enormous extent and Charleston vied with Wilmington in interest among those concerned with the handling or consumption of such commodities. Charleston naval stores reports began to appear in the market columns of the leading daily newspapers about 1874, and its receipts from day to day were soon chronicled as an item of business importance. Charleston, though, never snatched from Wilmington the honor of first place among naval stores ports. In 1882-83 its receipts of spirits turpentine and rosins, on which widespread attention was then more centered than on tar and pitch, apparently reached their maximum of 366,000 barrels, while Wilmington's receipts of the two commodities were much greater. The importance of tar and pitch visibly diminished after the war between the North and South. Vessels of steel construction were more and more driving the wooden ships from the ocean, persistently reducing the needs of the world for tar and pitch, while at the same time the calls for rosins and spirits turpentine were magnified by the new outlets created in an era that was peculiarly one of varied industrial expansion.

It is needless to detail the story of Charleston as a naval stores port of commanding prominence. It was destined to be a brief glory. The exhaustion of the South Carolina pine forests so far as heavy supplies of naval stores were concerned, was astoundingly rapid. Such a thing as conservation was undreamed of. The vast forests of Georgia and Florida and Alabama were too inviting to promote the thought of care in the use of what remained of the Carolina pine forests that had evoked the admiration of the early discoverers and explorers. No section of the primeval longleaf pine forests was more quickly or more effectively obliterated than that through which the "Tar Heelers" pressed on their way from North Carolina to Georgia. A very few years and they had cut their last boxes, hacked their last trees, gathered their last crops of crude gum, and, like an army of locusts leaving a Kansas wheat farm, moved on to fields new and pastures green. The subsidence of the industry was as rapid as its phenomenal

expansion. Its heyday was brief and its tale soon told. Charleston's receipts photographed with unerring accuracy the rise and fall of the industry in South Carolina. Here they are for the years that cover the period when the operators were literally chopping their way through to the Savannah river and leaving the worked out trees to the saw mill men treading close on their heels:

Year.	Packages.
1865-66	32,000
1870-71	90,000
1875-76	279,000
1880-81	283,000
1881-82	330,000
1882-83	366,000
1883-84	328,000
1885-86	200,000
1890-91	199,000
1895-96	81,000
1900-01	20,000
1903-04	11,000

Charleston continued a naval stores port of very minor importance, but it held such a subordinate position that little interest attached to it in trade circles. Strange to say, even when its receipts for an entire season would scarcely have totalled sufficient for a full cargo to Europe, it continued to furnish quotations through the press associations, an instance, one might say, of conservatism in trade practices continued beyond the point of reasonableness. Many a good humored witticism was made as a result of the serious publication of prices backed up by receipts of two or three barrels of spirits turpentine and rosins in proportion, and sometimes of no receipts at all. Like its North Carolina rival, Charleston years ago suspended the compilation of naval stores statistics, but unlike Wilmington, it has signally lost its entire position as regards naval stores. Whereas the name of Wilmington today is still synonymous with tar and pitch, Charleston fails to handle even those progenitors of the naval stores industry, or if they do ever reach the port the quantities, like those of rosins and spirits, are too small to arouse even passing attention. As a naval stores port Charleston has ceased to be—a striking warning to other ports of what must come to them unless policies of conservatism in working and of intelligent reproduction of the longleaf pine are adopted within the next few years.

VIRGINIA'S ACT OF 1720 TO ENCOURAGE THE MAKING OF TAR IN THAT PROVINCE.

Act of November 2, 1720—"Be it enacted by the Lieutenant-Governor, Council and Burgesses of this present Assembly, and it is hereby enacted, by the authority of the same, That the sum of twelve hundred pounds current money of this Colony, be appropriated and paid to the person or persons, who shall make, or cause to be made, good and merchantable tar, which shall be made from green trees prepared after the following manner, that is to say: that when such trees were fit to bark, the bark thereof was stript eight foot, or thereabouts, up from the root of each tree, a slip of the bark, of about four inches in breadth, having been left on one side of each tree; and that each tree, after having been so barked, had stood one year at the least, and was not before that time cut down, for the making of tar. Which said sum of twelve hundred pounds, shall be given and paid, as a reward or premium, for the making and exporting of tar, after and according to the rates following, that is to say: For every barrel of tar, made according to the above directions, the sum of two shillings, current money of this Colony."

MINING FOR ROSIN IN THE OLD NORTH STATE

(By Thomas Gamble.)

FROM the day the distillation of spirits turpentine from the crude gum began until as late as 1892 the molten rosin from the still, instead of being run off into barrels, was frequently turned into a channel that led it into a branch, or creek or river or lake, or to a low place in the land. This was particularly true in North Carolina, and in a less degree in South Carolina. It was the outcome of an absence of markets that rendered it unremunerative to attempt to ship the stuff. In the earlier days of the industry in North Carolina it applied to rosins irrespective as to whether they came from the virgin dip or from boxes that had been in operation for several years. Later, when pale rosins became somewhat in request, only the lower grades were unprofitable and found a depository beneath the water or went to fill up hollows in the face of old mother earth. Even when prices for all grades of rosin had become somewhat fixed and the demand covered everything from the finest to the darkest, there were stills so situated with respect to railroads or water transportation that it did not pay when the market had reached a low level to bother with the rosin. This was the case as late as the "panic" of 1892, at which time the operators whose stills were badly located with regard to the expenses of transportation resorted to the expedient of the pioneers of the industry and once more made an entirely waste product of the residue left from the distillation of the spirits turpentine. Scattered all over North Carolina were little graveyards of rosin, frequently forgotten locations, but quite often known to local repute as rosin beds.

When it is realized that in the heyday of the naval stores industry in "The Old North State," there were over fifteen hundred stills in operation, that railroads were conspicuous by their absence over large parts of the turpentine belt, and that at times the quotation at the port for low grade rosins sank away below a dollar—even reaching as a minimum, perhaps, the insignificant item of 25 cents—it is possible to appreciate that untold thousands of tons of rosins found what was thought to be their last resting place in gulleys and beneath the running streams or in the spring-fed lakes or in mill ponds. That some day these beds of rosins would be sought for and mined was beyond the wildest stretch of the imagination of the turpentine pioneers or even of those who came in later periods of naval stores activities. The virgin forests seemed inexhaustible, the cost of production was low, to the south for a thousand miles stretched a wilderness of pines, why should anyone ever essay to recover and market the rosin that had been cast aside with reckless prodigality?

But the time of exhaustion of the pine forests of the Carolinas came. The era of industrial expansion had likewise brought ever increasing avenues of consumption for rosins. Instead of a pittance for a barrel of low grade rosins they in common with fine rosins began to command a figure that meant at least reasonable profit. Men's thoughts were directed to the deposits that represented wasted energies of bygone decades. It is one of the romances of the industry that the inception of rosin mining came from a Federal soldier, one of Sherman's army, named Waterhouse, who on the march through North Carolina learned of a large bed of rosin in Harnett county, near Angier, and returning a year or two after the cessation of hostilities bought the right to exhume it and had the distinction of being the first man, as far as known, to become a rosin miner. Prices were then high enough to make the venture profitable, but with the re-establishment of the regular sources of production the markets declined and operations of this kind received scant encouragement. It was not until perhaps twenty years ago that regular scouting for old rosin deposits began and soon developed into an interesting side branch of the great naval stores industry. At first the land beds received attention. They were easier to locate and easier to work and their treasures were made merchantable at the least expense. Every neighborhood had its memories of old turpentine stills, their locations in many instances were not difficult to find, and a little exploration soon revealed whether there were rosin deposits sufficiently large to justify mining. An overlay of sand of several feet often concealed the bed but once the rosin was discovered the cover of half a century or more was speedily removed, negroes with pick axes were put to work, and in a short time rosin that might have been anywhere from twenty to seventy-five years old, was being shipped to market. Protected from the elements of the weather there had been no disintegration and no loss of any of the qualities possessed by the rosin the day it came as a fluid from the still.

The land deposits were the more numerous, the more readily located and worked, and for some years commanded the attention of the prospectors and operators. How many thousands of barrels of rosins were mined no one can say. It would be purely approximate guess work to venture on figures, yet old experienced miners say with positiveness that the quantities recovered must have run in the course of the last twenty years well beyond the 100,000 mark. It may be that the old beds have given up of their hidden treasures that much or more. A few hundred barrels here and a few hundred barrels there, an occasional deposit that yielded a thousand or two thousand, a ceaseless hunt and a constant operation would naturally turn out unexpectedly large totals of rosins in the course of two decades. When one of those who have led in this reclamation of buried rosin states that he alone has marketed 20,000 barrels, it may be conjectured that the estimate of 100,000 barrels is too low and that a closer approximation to exactness would run into larger figures.

From the land to the water deposits went the eager miners of rosins as the inroads on the former made it increasingly difficult to find large and profitable beds. Little creeks into which rosins had flowed were hunted up and forced to disgorge their wealth. There was but little difficulty experienced in this class of reclamation. Frequently only the portion of the bed that was comparatively easy to handle was utilized, an unknown quantity of the deposit being left behind when operations were suspended. Generally the bed had been sufficiently robbed of its contents to make it unprofitable for later comers to venture on further operations. Year after year the numberof available beds that promised sufficient remuneration to justify mining became less until in the last few years the prospector has been forced to be unduly vigilant in his efforts to locate a virgin bed of sufficient size to offer a prospect of much reward. Rumors still tell of deposits here and there near the shore lines of fast running rivers, no doubt there are small deposits near the sites of stills whose owners have passed into dust and whose names have gone from the memory of man, but the harvest has been largely mined. But a short time and the field will have been exhausted and the mining of rosin in the Carolinas

View from the Kettles, Looking North across the Pit, Coffer Dam and Lake Catherine

will be but a reminiscence of the industry, an interesting historical sidelight on one of the earliest of America's colonial enterprises, for the naval stores industry came into being when the first settlements were located and has an unbroken record of more than two centuries.

Last among the mining enterprises of some magnitude is that now being conducted by Mr. Percy L. Gardner and brother at Catherine Lake, Onslow County, North Carolina, some fifty miles from Wilmington. It is one of the largest operations of this character, perhaps the very largest, and has the additional advantage of being conducted at a time when the rosins command such high prices as to justify the extraordinary expense necessary to institute the uncovering and purifying of the rosin. Were it not for the fact that the lower grades of rosins command such prices as now it is doubtful if the initial outlay of thousands of dollars for the erection of a cofferdam would have been justified. Catherine Lake is one of the most attractive little spots to be found in Eastern Carolina, a spring-fed body of purest water covering some seventy-five acres, with a depth reaching to twenty-five feet, swept by cool breezes on the hottest of days, with no apparent outlet for its waters and, the local enthusiasts say, inhabited by pickerel three feet long and bass of 12 to 14 pounds in weight. A century ago it was the center of a great plantation, the story of whose turpentine operations is told elsewhere in this volume, and at various times on its border, within a radius of four or five hundred feet, six stills had been operated, probably all of which in a way found convenient dumping place for their rosins beneath the soft and placid waters of the lake. The main still, operated, it is said, for probably half a century, running back to the early 30's of the last century, is not far from the county road to Jacksonville, N. C. From it a stream of despised rosin slowly edged its way to the nearby water and was swallowed up by the lake whose smooth face told no tale of its concealed riches.

Around a curve of the lake shore to the right, when the war was on between the States, and the Federal forces found their way into this section of the State, a thousand barrels or more of rosins had been accumulated, potential wealth if only transportable to the hungry markets of the world. One day there came the military order from the Confederate commander of the district that all turpentine and rosins not removed within ten days to a place of safety from the marauding foes must be destroyed. It was impossible to convey the rosins across many miles of country and so reluctantly the match was applied. It was a wonderful bonfire with vast clouds of black smoke obscuring the sky. As the fire spread from barrel to barrel a great stream of melted rosin began to find its way to the lake and soon a perfect river was pouring into the water and once more becoming a solid mass. There it has laid for fifty-five years. Gradually a sediment of sand formed over it. Today it awaits the construction of a dam, the pumping of the water that conceals it, and the picks of the negroes to make it available for the pot and the straining vat.

But the operations of today are on the mainland and the bed of rosin that is being exhumed if it could tell its story would carry one back to the days of primitive wildness in this section. It was three years more than a century ago when the original owner of the lake and all its surrounding lands for miles settled here with his slaves and became one of the land barons of the State. He was master of more than he could survey—vast domains of pine trees that had been growing when the English first settled Jamestown, cleared stretches of untold acres on which cotton and corn and other products could flourish. When he first began his naval stores operations is not known. It was probably not many years after he had established himself and settled down to a condition of life that no man then believed would ever be ruthlessly disturbed and torn up by the roots by civil war. The turpentine or crude gum found a ready market in New York or Boston or at Wilmington, spirits of turpentine brought its accretion of wealth, tar and pitch, if he saw fit to turn the labors of his negroes in that direction, yielded modest profits. In all likelihood one hundred years ago his slaves boxed the trees and chipped their faces, and from the ducts poured the gum that later on we are told brought to him as great an income as $60,000 in a year. He had no labor troubles. His workmen did his bidding and under his system of management discontent is said to have been noticeably absent.

The slope of the lake nearby the location of this especial still is very pronounced. But a few feet from where the waters lap the shore the bed of the lake takes a sudden drop. Twenty-five or thirty feet from the shore line the water is twenty-odd feet in depth. It makes a natural pocket into which vast quantities of rosins could run and be swallowed up apparently forever. And there for a time that runneth beyond the memory of any man living in the vicinity a bed of rosin grew in breadth and depth. Reaching the water in a molten state it quickly solidified into an impervious mass. There, too, certain debris from the still, the dross and old staves and hoops, found what was deemed their last resting place, a contribution to the lake for eternity. Occasionally a careless negro in some way let go a barrel of scrape, or in later days, when rosins were marketed, a barrel of rosin, only to see it likewise find a grave within the lake. A veritable naval stores cemetery for half a century to which no man gave hope of a resurrection. But the resurrection nevertheless came.

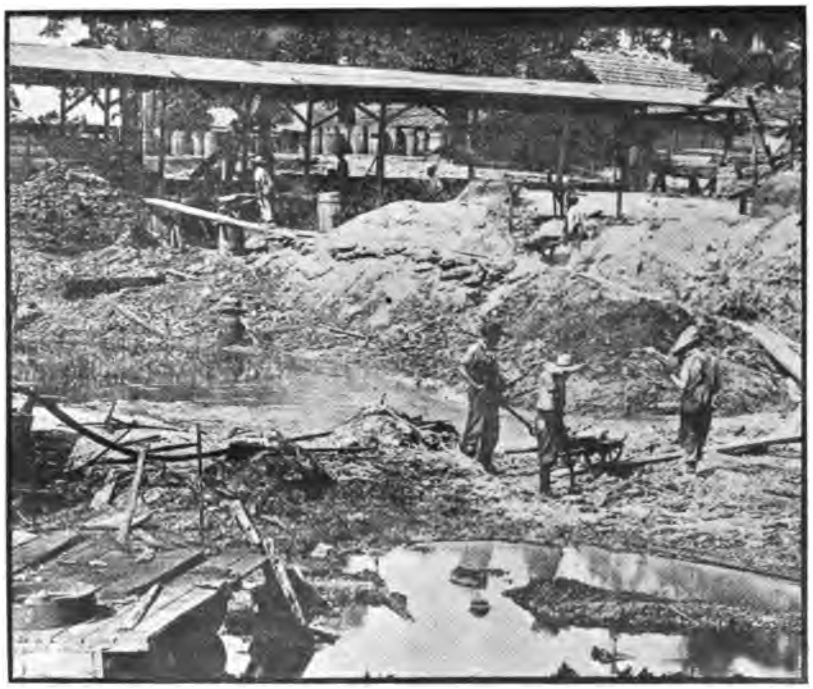
For years Mr. Gardner and his brother have been successful exploiters of old rosin beds, aqueous and otherwise. Many a treasure trove has surrendered its wealth to them. And so when they

heard of the possibilities that lay within the bosom of Catherine Lake it was but a matter of time before the rights to mine for rosins had been purchased. Late last fall began the construction of the dam, no small enterprise with twenty-odd feet of water to be overcome and springs feeding ceaselessly from the bed of the lake. Feeling out the lay of the rosin the dam's contour was fixed just beyond what seemed the confines of the mass. The sandy bottom seemed to give when efforts to drive piles were under way and some skillful engineering was necessary to construct a dam that would stand the pressure of the wall of water it was intended to hold back. By early spring it was completed, the water between it and the shore line pumped out and the removal of the overlay begun. It was no easy task to get rid of the debris of a generation or two. Three to five feet of sand and trash was carted out and then the bed of rosin lay like a rock of unknown depth. It was hard work, even for the strongest of negroes, to dig out the debris welded together as it was with staves and hoops and barrel tops and sand. In veritable strata the rosin told the story of successive runs at the still. Some old cannon balls came up, relics of the War of 1812, in all likelihood, and strange to say, the top of an old gunpowder barrel, with its advertisement of paper pasted on just as clean and just as clear as when it came from the mill away beyond the war between the States. Protected by the rosin from any disturbing influences it had rested secure for seven or eight decades.

View of the Barrel Pit and Vat, Kettles and Crude Rosin in the Bin in the Background

Once broken up into fragments the handling of the rosin has been a comparatively easy matter. Where the still stood in bygone days a rough shed covers the vat in which the rosin is now melted. Careful skimming clears away the trash and then it is run through the wire strainer into the trough and dipped into the barrels and made ready for the market. It is an ideal spot for work. The odor of the boiling resin, the fragrance from the pines, the gentle breeze from the lake, the quietude of the scene, all combine to make it pleasing to the senses. Fifteen hundred barrels of rosins have already been taken from the bed, but the main source of rosin wealth is believed not yet to have been touched. Down toward the dam it may lie in an unbroken mass to a depth of ten to fifteen feet. Where it has already been mined the rosin has been five or six feet in depth. Three thousand barrels of B, D, E, F rosins will be taken from the deposit, at a minimum estimate, and it is entirely within the range of probability that five thousand will be reached. The area enclosed by the dam is about 200 feet in an irregular direction.

As stated, this is doubtless the last of the great rosin beds of North Carolina. Those of South Carolina were few in number and importance compared with those in its sister State to the north. When the beds at this spot have been worked out the dam will be taken away, the sheds and debris removed, the waters will once more flow back to the shore line, and the turpentining days at Catherine Lake will become a more and more indistinct memory, a shadowy ghost in local tradition.



View from Coffer Dam, Looking Across the Rosin Mine or Pit, Where Ten Feet of Water has been Pumped Out

"Tar Heelers" Making Pine Tar

HOW PINE TAR IS MADE IN THE SOUTH ATLANTIC STATES

1. Building the Kiln 2. Starting Fire 3. Raking Back Coals 4. Tar Coming From Kiln 5. Dipping and Barreling 6. Working Around Kiln 7. After Hard Day and Night 8. Tar-Makers at Home 9. Burning Completed

WHO does not know of the tarred rigging which once meant so much to the ropemaker? Its very odor seemed to cling to the pages of seafaring books. Its use naturally declined with the development of steam power, yet how few people, perhaps, realize that tarred goods for quite different purposes form an important though incidental branch of the rope business today! Lath-yarn—to mention but one class—is consumed annually by the lumber industry in quantities that would surprise many persons. Today's buyers, furthermore, need goods of high quality just as did the old-time sea captains, and in the manufacture of such goods the tar itself is an important factor.

Pine tar—the kind best suited for cordage—comes from various members of the pine-tree family, and is secured by a distillation process. The principal producing sections are northern Europe

and the southeastern United States—the yellow, long leaf or Georgia pine, which ranks first in this country for tar-making, growing in a territory about one hundred and twenty-five miles wide along the coast from North Carolina to Texas.

Of the two methods for extracting the tar—the old kiln and the modern retort processes—the second yields the greater supply, largely because of the more systematic manner in which the industry is carried on.

Tar-kiln burning is conducted so far out in the country and in such a desultory fashion that few people have the opportunity to become acquainted with the process. A brief description may, therefore, be of interest. Only dead wood is used, as the green tree does not yield the quality or quantity of tar necessary to make the work profitable. Among the tar-makers the material is known as fat lightwood, possibly from the fact that it ignites easily and burns rapidly. In weight and color it is anything but light wood.

The wood is cut into convenient lengths and then laid up, with the ground as a floor, to form a pile about twenty-five feet long by five high and tapering in width from eight to five feet. The soil, if soft or sandy, is first covered with clay to lessen the loss of tar, and the pile is usually built on a slope so that the liquid will flow toward the pipe which serves as an outlet.

The kiln is completed by covering the wood with "pine straw" and sand. This prevents air currents and keeps the fire, which is on the back end, from drawing through and consuming the wood without producing tar. Moreover, while the kiln is burning—a period of two weeks or more for a twenty-five cord pile—it must be watched day and night so that straw and sand blown off by the gases within may be replaced at once.

As the tar comes from the kiln it is caught in a hole dug beneath the outlet and is dipped up and poured into barrels—the average yield being one barrel to the cord. The tar is then hauled by cart to water or railroad, thence to be transported to the various naval stores yards.

The tarring of rope is a very simple process. The material used is either Russian or American (Wilmington) pine tar. After the nets are completed, the fisherman, and sometimes the manufacturer of nets, does tar them with a mixture of pine and coal tar, but nothing but pine tar is used by the leading manufacturers.

The receptacle that holds the tar is technically known as the "copper." It consists of a copper tank either boxed in or in a heavy wooden frame. There is a strong vegetable acid in tar, and iron tanks will not remain tight for any length of time; but this vegetable acid, although it attacks iron, does not injure fiber to any extent, and the cause of a tarred rope having less strength than a rope untarred is principally because of the effect of heat in tarring the fiber, which injures the elasticity of the fiber. The length of the copper has a great bearing on the speed with which the tarring process is carried on. At one end of the copper is a frame with spindles on which are placed the bobbins of yarn or rope that is to be tarred; at the other end the capstan rolls which draw the yarn through the warm tar. From these rolls the yarn is carried to frames where it is taken up on other bobbins, friction driven. At the end of the copper is a wringer, that is, a machine with iron rolls by which the surplus tar is pressed out of the yarn, tests occasionally being made to see that the percentage of tar in the yarn desired is being obtained.

The tar has first to be brought to a temperature of 210 to 215 degrees, so that any water or moisture in the tar may be boiled off before the process of tarring is begun; then the tar is kept to a temperature of practically 200 degrees Fahrenheit through the operation.

Most tarred rope is tarred, as the ropemaker expresses it, "in the yarn"; that is, the individual yarns are tarred before they are formed and laid into a rope. On ropes of small diameter, like ¼-inch, 5-16-inch, and ⅜-inch Net Rope, it is tarred "in the rope"; that is, the finished rope is tarred. These small ropes are usually tarred at the same time as a quantity of yarn, the latter serving as a cushion above and below so that the shape of the rope is not distorted when it goes through the nipper or wringer which takes out surplus tar. (See footnote.)

[Thanks are due the Plymouth Cordage Company, of North Plymouth, Mass., for data furnished and the use of the illustrations in this article.]

How the Finns Make Tar and How They Market It

(By U. S. Consular Assistant F. LeRoy Spangler, Helsingfors, Finland.)

ALTHOUGH the production of tar still plays its part in Finnish industrial life, it has now become quite insignificant compared with its importance 50 years ago. The following table gives the approximate annual quantity and value of the tar exports for periods since 1863, when the industry was at its height, after having been stopped almost entirely during the Crimean War.

Periods.	Hectoliters (a)	Marks (b)
About 1863	300,000	....
1875	200,000	3,000,000
1886-1895	148,000	1,810,000
1896-1905	89,000	1,420,000
1906-1915	17,000	401,000
1916	18,755	1,875,000
1917	1,571	251,000
1918	47,814	6,595,333
1919	11,638	2,604,031

a 1 hectoliter—26.4 gallons.

b The par value of the Finnish mark is 19.3 cents.

The Finnish mark began to depreciate from its normal value of 5.18 to the dollar at the beginning of the war, until toward the end of the year 1919, when it had reached a rate of over 30.

In 1918 the stocks of tar held over during the war were exported, causing a considerable rise in the price, but during the year 1919 the price dropped to 200 marks per hectoliter from its previous level of 400 marks.

The following primitive method of getting tar, which, fortunately is being done away with, was used extensively. The bark is stripped off each pine tree to a height of 7 or 8 feet, a narrow strip being left on the north side, where the bark is strongest, in order to preserve the life of the tree. This stripping goes on for three or four years, or as long as the tree will stand it, each time a little higher, and a thick yellow resin oozes out of the peeled wood and form a thick crust on the trunk. When the last treatment takes place the narrow strip of bark that has been left on to preserve the tree is also removed, and when the snow is on the ground those trees which have had their final treatment are felled and carried on sledges to the tar kilns, which are huge, saucer-shaped affairs constructed of wooden logs bricked over and cemented, and are usually built along the river banks.

The tree trunks are cut into pieces of about a yard in length and piled upon the kiln, then covered with turf and kindled at several points. The kiln smolders for a couple of weeks, the resin crusts of the trunks gradually melting and the tar flowing down the kiln to the hole in the center, with which pipes are connected that conduct the tar into barrels. Most of the kilns are large enough to yield more than 100 barrels, or 40,000 pounds, of tar at one burning. If the kilns are not situated near any waterway, the tar is transported to the rivers by fixing the barrels to axles held together by beams of wood, so that the barrels themselves act as wheels, and in this way the horses can pull them over the rough roads very easily.

As soon as the ice melts in the rivers the tar boats appear and carry the barrels downstream to the coast. Most of this transportation by tar boats is done on the Ulea river, which is full of rapids, and down which the boats shoot at a tremendous rate of speed, piloted by expert steersmen. The boats are about 40 feet long and only 3 feet broad, very lightly built, so as to yield before a slight shock, but with lofty sides to keep out the foaming water. There is seldom a single nail or a piece of iron of any kind in their structure, the thin planks being bound together with the stoutest wood fiber, after which the boat is liberally coated with tar.

A boat will carry about 30 barrels, or 6 tons, of tar on each trip, but it is built so light that it can be pulled up the rapids again on the return journey. The crew generally consists of a steersman at the stern, two women amidships to row in the calm water between the rapids, and two boatmen in the bows. Many tar boats make as many as three journeys down the Ulea river to the coast during the short summer, and they never return empty but bring back with them a small load of provisions for winter use. Most of the peasants who are employed during the summer in burning and transporting tar spend the hard winter in felling trees and carrying them over the snow to the tar kilns or in making strong barrels for the tar.

Tar burning has been an important business in Ostrobothnia since the sixteenth century, but it has resulted in a wasteful destruction of fine pine forests. Enormous tracts of pine wood, especially in Uleaborg and the interior of Vasa, have been either destroyed or replaced by firs because the pines were cut down when 40 to 80 years old and used in making tar. Since 1863, the boom year of this industry, ships of iron and steel have largely taken the place of wood vessels and tar has since been in less

Tar Burners at Work at a Kiln in Finland

demand, fortunately for Finland's valuable forests. The tar burners are now beginning to make use of other material, such as stumps, roots, waste from sawmills, and young trees cut down where the forest growth is thinned—raw material for which there is no other use. It has been estimated that a large tar kiln will produce about $500 worth of tar at one burning; but considering the value of raw material and the amount of work required in transporting the tar to its destination, there is not much left for profit and wages. Nevertheless, more than 12,000 barrels of tar were exported from Uleaborg in 1908, and even during the summer of 1919, approximately the same amount was transported to this city, either down the Ulea river or by railway from various parts of Ostrobothnia.

The constantly increasing demand for wood pulp has raised the prices of the smaller fir trees, which are also used in tar burning, to a point where tar distilling was no longer profitable, and this has caused the industry to undergo very important changes during recent years. Most of the tar is produced nowadays in modern factories, transportation by waterways has given way almost entirely to railway transportation, and the center of the tar industry is no longer at Uleaborg, but along the railways between Tampere (Tammerfors), Jyvaskyla, and Seinajoki, whence the product is carried to the harbors along the southern coast. The northern districts, no doubt, will come into their own again as soon as railway communication has developed in this direction.

The location of these factories is dependent not only upon the railways, but also upon the abundance of raw material and the method of treatment. The method used by the modern tar factories consists in cutting into pieces and burning in furnaces the stumps of pine and fir trees, which have first been dried for several months in the air, after having been taken out of the ground. The stumps must be at least 7 years old and sometimes have been standing as long as 25 years, but opinions differ concerning the age at which the resin is well concentrated in the center of the moldering stump. Most of the factories are found in the central wood districts, where the stumps are very abundant and railway transportation is available, but the Nurmi-Kajana-Uleaborg line, which is under construction, will play an important part in the re-establishment of the tar industry in the northern districts.

Besides the tar itself, this industry results in minor products, such as crude resin, turpentine, pitch, lampblack, and charcoal. There has been some exportation of crude resin, which is scraped from the barks of the trees standing in the woods, but in 1918-19 a special organization for collecting the resin throughout the country found wages so high that exportation of the product caused a loss. The resin is now used in the rosin factories in Finland, where rosin is produced for varnishes and for the paper industry, which also imports large quantities of this material from

Watching the Tar Kiln in Finland

the United States. The following table shows the increase in the quantity and value of resin and rosin exported from Finland since 1910:

Years.	Pounds.	Marks.
1910	16,280	3,000
1913	425,260	68,000
1915	204,490	47,000
1917	813,560	554,000
1918	23,285	132,500
1919	789,000	1,459,629

The principal export markets for tar and rosin have been the Scandinavian countries, Germany, the United Kingdom, and Portugal, and recently the Netherlands. Special efforts are being put forward to develop this industry, and the outlook seems promising.

It seems to be impossible to procure accurate information concerning the amount of tar production, although that for the year 1919 has been roughly estimated at not more than 50,000 hectoliters, with a value of approximately 8,000,000 marks.

Import and export statistics, however, are readily obtainable, and the following table gives the latest figures published:

1919.	Amount.	Value. Mk.
Exports:		
Tar	11,638 hl.	2,604,031
Rosin & resin	789,000 lbs.	1,459,629
Turpentine	94,600 lbs.	312,396
Imports:		
Tar	25,794 hl.	3041,709
Rosin & resin	3,124,200 lbs.	5,135,862
Turpentine	39,600 lbs.	143,772

Practically all tar exported from Finland is wood tar, while the imports consist of coal and asphalt tar. The great decrease in the production of tar in 1919 is attributed to export restrictions and uncertain prices. Such restrictions did not exist in 1918, and as a result production was very high in this year. I am informed that America is the only country at the present time in which there is a large demand for tar, but the high cost of transportation prohibits its shipment there, the freight rates being almost as much as the price of the tar itself. Practically all the tar produced now is for domestic consumption. No tar is being produced this year for shipment next spring, because it is impossible to tell what the prices will be at that time. The high cost of production and the depreciation of the Finnish mark are also handicaps to the industry. The outlook is quite discouraging and production will continue to remain low until export restrictions are raised and prices become more stable.

Tar Boats at Kajana, Finland

Finnish Tarboat "Shooting" the Rapids

Tar Yard at Uleaborg, Finland

HOW THE FAMOUS "STOCKHOLM TAR" OF CENTURIES OF RENOWN IS MADE

[The following account of the making of tar by the peasants of Sweden appeared in 1914. The war is reported to have considerably diminished the demand for tar in Europe and nowhere is the industry reported in a flourishing state. Four or five centuries ago the tar from Scandinavia was an important article of commerce. It and the pitch and timbers from that section of Europe formed the "naval stores" of an earlier age and gave to the products of the pine the name that still holds to the industry, although the part they play with regard to the world's shipping in this twenty-first century of the Christian era is far removed from what it was when Queen Elizabeth drew on the Baltic country for supplies for the vessels that were to put the Spanish Armada to flight and carry the flag of England to the uttermost parts of the world.]

TAR has for centuries been manufactured in Norrland (Northern Sweden), especially in the northern parts of this large district, such as Lulea, Skelleftea and Umea, and in former days was shipped from Stockholm, and won world-wide recognition for its superior quality, under the name of "Stockholm Tar." After 1900 an alteration took place, and exporters at Umea, Skelleftea and Lulea have themselves taken charge of the export, thus becoming independent of Stockholm.

Umea has been the leading place for this trade, especially for the packing, and Umea tar therefore enjoys a very good reputation. However, the tar shipped from Lulea and Skelleftea is of exactly the same quality, as the manufacturing process is the same. The ports of Lulea, Skelleftea and Umea are, therefore, competing for the shipment of the same quality of tar. The difference has been in the packing, but even this has disappeared more or less in recent years, and the tar shipped from these three ports has been packed in barrels of the "Wasterbotten" type, thereby making the production uniform. As regards output, Skelleftea and Umea showed before the World War a declining trade, but Lulea, owing to its geographical position, had considerably increased its shipments. Before tar exporters had offices in Lulea, nearly all Lulea tar was shipped either from Skelleftea or Umea. Lulea tar was formerly shipped in barrels of the "Norrbotten" type. These were not so satisfactory as the "Wasterbotten" type, and almost disappeared, only being used for the tar burnt along the River Thorne, on the Finnish frontier, which tar is shipped from Haparanda. Consequently, the so-called "Haparanda tar," which has been described as being similar to such Finnish qualities as Uleaborg and Wasa, fetched a lower price than the other Swedish peasant-made tar. This is quite natural, as the leakage of the old-fashioned type of barrel is sometimes considerable—which importers in the United Kingdom and on the Continent realized to their cost.

This Swedish peasant-made wood tar is being more and more displaced by the cheaper qualities, such as kiln and Russian tar, which, however, cannot be compared with it. The most valuable ingredient in peasant-made tar is turpentine, which accounts for the difference in price. Those users who value a first-class tar must, therefore, use the genuine peasant-made tar, which cannot be surpassed by any other quality, and thus obtains the best price in the world's market.

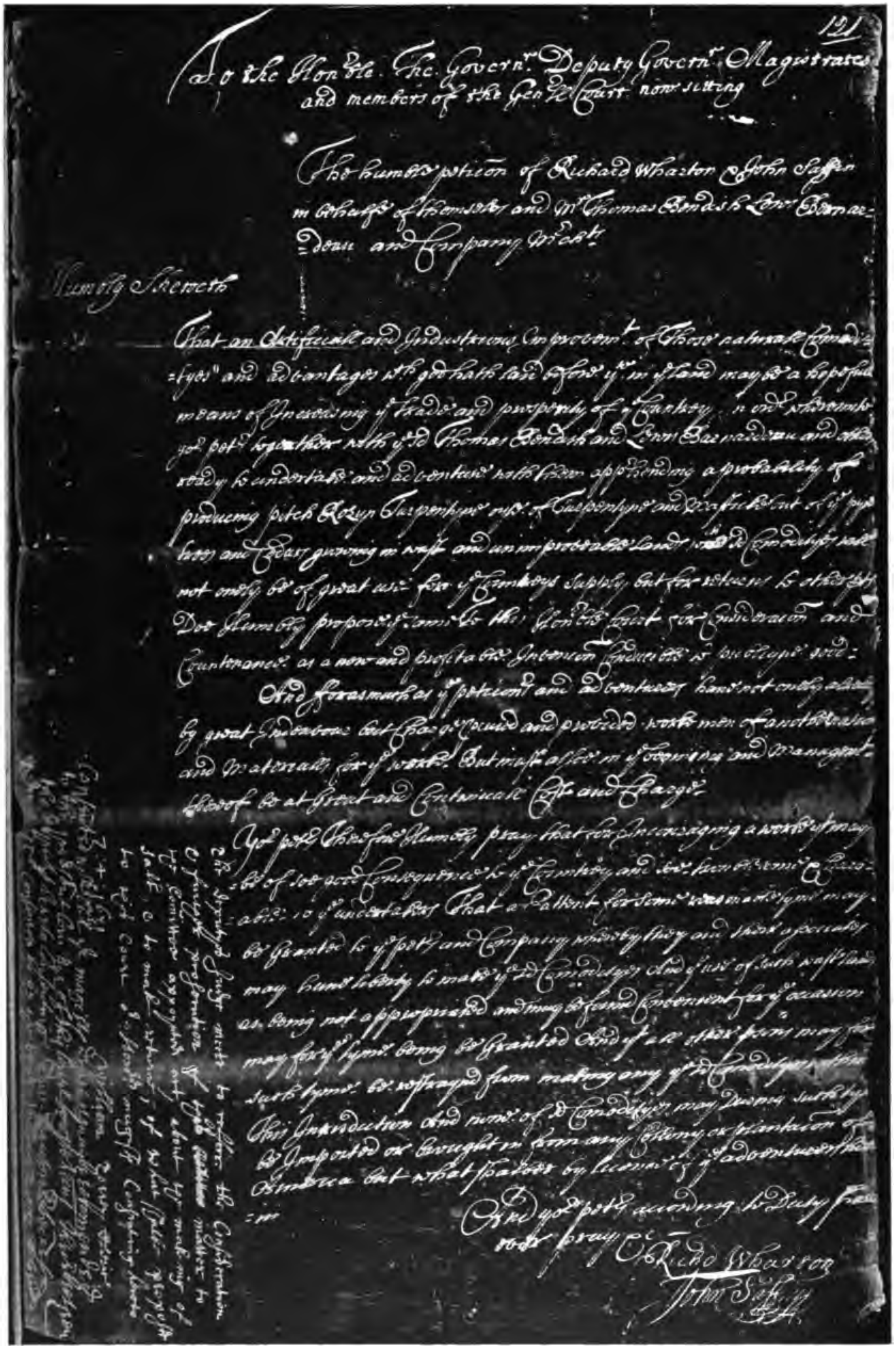
The burning of the tar is hard work. First of all, suitable roots must be dug up and cleaned in the autumn and winter, when this raw material can be taken on sledges to the tar "dale" or burning ground. Nowadays only the roots of Swedish pine trees (Pinus silvestris) are used. The peasants utilize the roots of trees felled for timber or of trees uprooted by storm. The roots are split at the "dale" and stacked for drying until early spring, when they are split into fine sticks. The "dale," or burning ground, is built of logs in a scientific manner. It is built on a slope, which sometimes forms one side, in the shape of a funnel, with a spout at the lower end of the slope. The outer walls of the "dale" are built with logs split in two, and a layer of earth is then placed thereon before the interior is lined, either with clay, iron sheets, or thick cardboard. At one time spruce bark was used instead of iron sheets or cardboard. At the bottom is the outlet, underneath which is a wooden channel or pipe leading the tar to the waiting barrel. The split roots are laid in layers in the "dale," which is afterwards covered with peat and turf, whereby the fire is regulated. The process is similar to that of charcoal burning. The fire must not be too fierce, and is only allowed to burn slowly and in parts. If it flares up, peat or turf must be put on to damp it down.

Before the tar burner has proceeded so far, he must attend to the manufacture of the barrels, which must be ready for use before the fire is lit. The timber for the barrel is also cut in the autumn, and dried during the winter. When the necessary number of barrels is completed, and been stamped with the "control" mark, the "dale" is ready to be fired. Firewood is used for this procedure. The roots are not burned, but only sweated. Calm weather is necessary for complete success. A strong wind is very dangerous. During the burning a large number of men are employed day and night in watching the distillation. The fire must not find its way to the spout or channel, because if the tar is ignited the "dale" may not only be destroyed, but the fire may spread and destroy the whole stock. This is not an unusual occurrence. Two men are required for attending a small "dale" for, say, about 40 barrels, and three or four men are needed for a larger "dale" for 100 to 120 barrels, for several weeks. The burning takes place during the summer. As the "dales" are situated far away from the roads, cartage can only be effected by sledges when snow has fallen. The barrels are taken to the nearest railway station, where often the local grocer receives them against payment for coffee, sugar, flour, and other necessities. The price he calculates is, of course, low-

er than that he obtains as a middleman from the tar exporter. The prices vary very much for different years, and it is difficult to give an average.

An average "dale" gives from 30 to 40 barrels, and the work is hardly remunerative, considering the great care and labor expended and the risks taken. The tar burner has also to pay to the Crown 75 ore (10d.) per barrel for such roots as he may have taken from Crown property. The barrels used are either one-quarter or one-half barrels, and they are sent down to the port for shipment, where they are warehoused until shipment.

If the wood has been well dried and the weather favorable during the burning nothing will mix with the tar except what is called "brown water." As this water is heaver than the tar, it goes to the bottom of the barrel and is drawn off by the so-called "wrecking" process. Water will appear on the top of the tar if the wood has not been well dried, or if rain has fallen during the burning. This water is generally taken away by skimming, and the barrel is filled up before shipment. This process, which is part of the "wrecking," is carried out very carefully at Lulea, each barrel being opened, and the contents "controlled." The barrels are always filled up alongside the vessel loading, and thus the buyers are assured that they do not lose anything by leakage, except what may be lost during the voyage. The old method of "wrecking" is as follows: In the bottom of the barrels there accumulates a certain quantity of black, half-burnt tar which, of course, sinks to the bottom on account of its heaviness. When the barrels are "controlled," this is drawn off as bad and the barrel is filled up with good, saleable tar. In order to ascertain the quality of the remaining tar, a steel rod is put into the barrel, and if the tar which adheres to the rod when taken out is black and smooth, it is classed as "prime," or first quality. Barrels containing such a quality are marked "1." If the tar is thick or grained it is called second quality, and the barrels are marked "2." If the tar is very coarse-grained, it is considered to be of inferior quality, and the barrels are marked "0." "Wrecking," or controlling, is nowadays done so carefully that exporters seldom receive complaints or claims.



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To the Hon^ble. The Govern^r. Deputy Govern^r. Magistrates and members of the Gen^ll Court now sitting

The humble petition of Richard Wharton & John Saffin in behalfe of themselves and M^r Thomas Bendish Lenn^t Barnardeau and Company

Humbly Sheweth

That an Artificiall and Industrious Improvem^t of Those naturall Commodityes and advantages w^ch god hath laid before y^e in y^e land may be a hopefull means of Increasing y^e trade and prosperity of y^e Country ... yo^r pet^rs together with y^e s^d Thomas Bendish and Lenn^t Barnardeau and others ready to undertake and adventure hath been apprehending a probability of producing pitch Rozin Turpentine ... out of y^e pyne trees and Cedars growing in wast and unimprovable land ... not onely be of great use for y^e Countreys supply but for returns to other parts Doe Humbly propose y^e same to this Hon^red Court for Consideration and Countenance as a new and profitable Invention ...

And forasmuch as y^e petic^rs and adventurers have not onely ... by great Endeavours but charge procured and provided workmen ... and materials for y^e worke But must also in y^e carrying on and managem^t thereof be at Great and Continuall Cost and Charge

Yo^r pet^rs Therefore Humbly pray that for Incouraging a worke y^t may be of soe good Consequence to y^e Country and ... That a Pattent for Some ... be Granted to y^e pet^rs and Company ... may have liberty to make y^e s^d Commodityes ...

And yo^r pet^rs according to Duty shall ever pray &c.

Richd Wharton
John Saffin

Copy of the Original Petition Under which Massachusetts Established a Monopoly in the Producing of Turpentine, Pitch, Masticke (rosin) and Tar in 1671.

NAVAL STORES MONOPOLIES CREATED BY THE PILGRIMS AND THE PURITANS

(By Thomas Gamble.)

MONOPOLIES were a long favored method of procuring revenues for the government, of rewarding favorites of the Crown at the expense of the public, or of promoting the manufacture or growth of commodities especially desired for governmental purposes. The abuses of the system led in the times of James I to a statute abolishing the existing monopolies with certain exceptions, prominent among which were the manufacture of war supplies and materials.. This was in 1623 and it was in accordance with the spirit of this Act, no doubt, that the New England forefathers, nearly a half century later, (1671) provided for a monopoly of the manufacture of naval stores in the Massachusetts Bay Colony. This was in 1671. Wilmington at that time did not exist. It was not founded until 1730. It was eight years later before Charleston was settled. And sixty-one years were to pass before Oglethorpe's settlers landed on Yamacraw bluff.

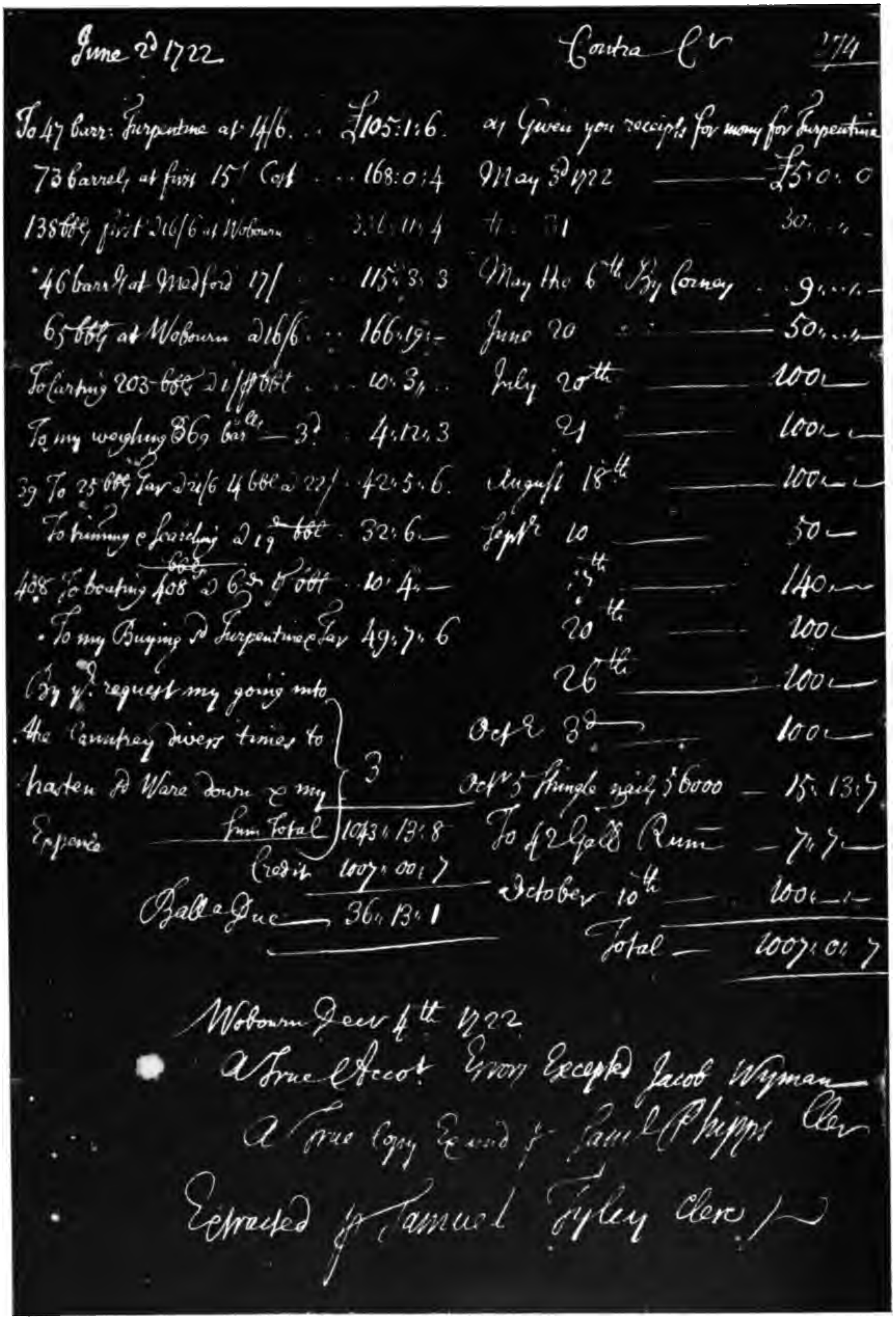
Naval stores had long been made in the older colony of Plymouth, as well as in Massachusetts. One of the earliest steps of the Pilgrim Fathers was to request in 1628 that "men skylfull in making of pitch" be sent out to them from England. They appreciated the needs of the home country for that and kindred articles, they realized that the pines about them could be made to produce a money crop, and that while serving England's interests they would at the same time be promoting their own financial welfare. While the confines of the colony were small, considerable progress was made in the production of pitch and tar, so much so that the forests diminished somewhat too rapidly. Whether it was for this reason or some other does not appear clearly, but in 1665 the General Court of the colony rigidly restricted production, in the following Act:

"It is enacted by the Court that noe master of a family shall make or cause to be made within this Gourment aboue the number of sixteen barrells of Tarr for this following yeare vnder the penaltie of three shillinges p barrell forfeite to the Collonie; and euery single pson is heerby prohibited from makeing any Tarr directly or Indirectly for this following yeare vnder the aforsaid penaltie; and this order to take place from the first of march next ensueing the date heerof." Three years prior to this tar had been included in the articles subject to an excise tax, revealing its importance as a subject of special tax consideration. The Pilgrims of the second and third generations were keenly alert to revenue producing commodities, not unlike the average legislator of today, and in casting about for a source of income they seized upon tar:

"It is enacted by the Court that all Tarr that goes out of the Gourment; six pence a barrell bee payed to the Countrey; vpon all such Tarr as shalbee made; on any lands that are within any Township; and twelue pence a barrell on such as is gathered on the Countreyes Comons; and that the same course bee taken for the entery thereof before any bee carryed away on penaltie of forfeiting foure shllings a barrell for any soe carryed away; prouided that all such Tarr as is made or shalbee made att any time within this Instant month of June shall not fall vnder this order."

To Plymouth likewise falls the honor of taking the first steps to establish a monopoly, although its procedure to that end differed from the method adopted in the more populous and larger producing sister colony into which it was soon to be absorbed. In Plymouth the policy was adopted of compelling the sale of all tar produced to certain persons at prices fixed by the government, insuring a stable market and doubtless protecting and promoting the interests of the producers by guaranteeing the prices to be received. Fluctuations were not looked upon with favor and the modern conception of unrestricted competition had not yet taken a serious foothold in the science of economics. The General Court in 1760 ordered "that all the tarr made in the goument shalbe sold to some psons within the collonie, if any such will giue eight shillings in money for euery smale barrell, and twelue shillings for euery great barrell, during the full tearme of two yeares, and that during the said tearme noe tare shalbe transported or sold out of the collonie by any pson whatsoeuer but by or vnder those that engage to giue as aforsaid, vnder the forfeiture of all such tarr soe transported or sold, or the vallue of it; the one halfe to the collonie, the other halfe to the psons engageing as aforsaid." In accordance with this law eight men on June 24 announced to the Court their intention of taking for two years all the tar produced at such prices provided it was delivered to "some one of vs or some one of our order att the water syde in each towne in good marchantable caske and vpon due tryall made, found to be marchantable tarr." The fact that tar was made pretty well all over the colony was shown in the Court's order assigning the districts, or in the old English term, the "liberties," from which each of the buyers was to receive the commodity. "Fifteen gallons beer measure," was made the gauge for tar barrels.

The following year (1671) the General Court of Massachusetts Bay established a monopoly of production rather than of purchase. There are few instances in American history where this was done and the documents are of in-



June 2d 1722 — Contra Cr — 174

To 47 barr: Turpentine at 44/6	£105:1:6	By Given you receipts for mony for Turpentine	
73 barrels at first 15/ Cost	168:0:4	May 3d 1722	£50:0:0
138 bbls first 2l6/6 at Woburn	336:11:4	4 " 31	30:—
46 barrels at Medford 17/	115:3:3	May the 6th By Corney	9:—
65 bbls at Woburn 2l6/6	166:19:—	June 20	50:—
To carting 203 bbls 2 1/ pr bbl	10:3:—	July 20th	100:—
To my weighing 869 barrels — 3d	4:12:3	21	100:—
39 To 25 bbls Tar at 2l/6 4 bbls at 22/	42:5:6	August 18th	100:—
To trimming & searching 219 bbls	32:6:—	Septr 10	50:—
408 To boating 408 bbls at 6d pr bbl	10:4:—	13th	140:—
To my Buying ye Turpentine & Tar	49:7:6	20th	100:—
By yr request my going into the Countrey divers times to hasten ye Ware down & my Expence	3	26th	100:—
		Octr 3d	100:—
		Octr 5 Shingle nails 6000	15:13:7
Sum Total	1043:13:8	To 42 galls Rum	7:7:—
Credit	1007:00:7	October 10th	100:—
Ball. Due	36:13:1	Total	1007:00:7

Woburn Decr 4th 1722

A True Accot Error Excepted Jacob Wyman

A True Copy Examd pr Saml Phipps Cler

Extracted pr Samuel Tyley Cler

Copy from the Original Account for Purchasing and Handling Turpentine and Tar in Massachusetts in 1722
Probably Oldest Existing Document of its Kind in this Country.

terest. Herewith is given a reproduction of the original petition of those desiring the monopoly. Selfish personal interests were not supposed to enter into the creation of the monopoly. The public welfare was put forth as the governing motive—the expansion of the industry and the promotion of the colony's trade, and incidentally, of course, the freeing of the mother country from its dependence on the Scandinavian and Russian sources of supplies for its navy and merchant marine. On June 8, 1671, the petition was granted in the following order of the General Court:

"Mr. Richard Wharton and Mr. John Saffyn, merchants & company, hauing by their petition to this Court, proposed for the advantage of trade in generall, & raysing of vsefull comoditjes, not only for the occasions of the country, but for transportation, by way of returnes & supply to other countrjes, perticularly declaring they haue procured artists for raysing & producing great quantitjes of pitch, rozin, turpentine, ojle of turpentine, & masticke, for effecting whereof, as their is sufficjent matter (as they conceive) in the pyne & cedar trees of the country to produce the same, so it will be (as they alleadge) a matter of great charge to the vndertakers to effect it; therefore desire they may, vpon termes, haue the sole liberty for a considerable time to produce & make the same, & all others to be prohibited of that liberty within this jurisdiction.

"It is therefore ordered by this Court & the authority thereof, that no person or persons inhabitting wthin this jurisdiction, excepting the aboue sajd Richard Wharton, John Saffyn, & company, & their assigns, shall make or produce (any otherwise then hath binn practiced in former tjmes in this country) any pitch, rozin, turpentine, oyle of turpentine, or masticke of the pine or cedar trees in this jurisdiction, for the space & terme of tenn yeares next following the date hereof (excepting what particcular persons shall make for their oune vse, & not for sale,) and that no person or persons whatsoeuer, excepting the sajd Wharton, Saffyn, & company, shall import into this jurisdiction any of the aboue sajd commoditjes from any parts of America for the aforesajd, and these vpon the forfeiture & confiscation of the sajd goods or commoditjes so produced or imported, the one halfe to the informer that shall prosecute the same, & the other halfe to the country; and further, for incouragement to the said vndertakers, this Court doeth hereby grant them the vse of the pyne and cedar trees wthin the compasse of fiue thousand acres of land for that vse, in seuerall places, where they shall finde it most convenient for them, for the said terme of ten yeares, which is not appropriated or granted; prouided allways, that what of the sajd comoditjes the sajd Wharton & company shall make & produce shall be sold for the vse of the country at reasonable rates, the pitch & rozin not exceeding fiueteene shillins p each hundred weight, to be deliuered at Boston; and also pay sixe pence p cent of each of the sajd comoditys, pitch & rozin, of what they make out of comon timber, or els this present act & order to be voyd & of none effect as to any or so many onely of the sajd comoditjes they shall faile to make & supply the country wth all as aforesajd."

The question so often asked by those outside of the trade, and sometimes by those handling such commodities, as to how the term "naval stores" came to be applied to the products of the pine, can hardly be better answered than by reference to legislation of the General Court of the Province of Massachusetts in 1694-95, the two colonies having been merged under the control of the King in 1692. The British government, or as the Act puts it, "Whereas his majesty has signified his pleasure, that a tryal be made of the stores raysed within these parts of his dominions, for the furnishing of his royal navy, to the intent, therefore, that satisfaction be given unto his majesty herein," "the Governour, Council and Representatives in General Court assembled" proceeded in September, 1694, to prohibit shipments of "pitch, tar, rozin, plank and ship timber" without special license of the governor and council. The following year "in Obedience unto his Majtys Commands Signified by the Rt. Honble. the Lords of his Majtys most Honble Privy Council: Given at the Council Chamber At Whitehall the 5th day of April, 1694," the General Court of the Province appointed a committee to "consider and Report what Quantities of Pitch, Tar, Rozin, Planke Knee Timber and other Naval Stores for the use of his Majtys Royal Navy &c the Governmt here may undertake to send yearly into England, that an account attested under the hands of the Governor and Assembly may be transmitted." It was also voted "That a Ship Load of the Naval Stores above-mentioned, be provided with what Speed may be at the charge of the Publick, to be sent within ye Compass of the Year if possible," and a committee was appointed to secure the stores and the ship to transport them. An appropriation of four hundred and eighty pounds was made with which to procure the supplies. The shipload of naval stores doubtless went forward during the course of the twelve months. In June, 1695, the Committee reported and "The Lt. Governor and Assembly in all humility" advised the Privy Council "That his Majty may be yearly Supplyed from this his Territory with the several Species & Quantitys of Naval Stores hereafter mentoined for the use of his Royal Navy. That is to say. One hundred and Fifty Tuns of Rozin. One hundred and Fifty tuns of Pitch and Tar. Two thousand Tuns of Timber, as Standard Knees, Compass timber, Clamps, Beams, Futtocks & other Timber. One hundred Thousand Feet of Oak Plank. And when the hazards and troubles by the Indians are over, greater Quantitys of each of the said Species may annually be procured."

As in the Carolinas in later years, naval stores became commodities by which payment could be made of public dues. As late as 1721 it was provided in Massachusetts that "The Inhabitants of this Province shall have Liberty (if they See fitt) to pay the Several Sums, that shall on them be Respectively Assessed, in the Several Species hereafter mentioned, at Such Moderate Rates, & Prices as the Great & General Assembly shall Sett them, Vizt. * * * Pitch, Tar & Turpentine."

Herewith is given a fac simile of an account for the purchase and the handling of naval stores, made in 1722, probably the oldest original American document of this kind which can be found. From this and the other evidence presented in this article and the one dealing with other phases of the early history of naval stores in North America, it is quite evident that this is the oldest industry on the continent, antedating any other still in existence in the United States.

HOW THE SAVANNAH BOARD OF TRADE FIXES PRICES AND REGULATES THE TRADE

(By Thomas Purse, Secretary Savannah Board of Trade.)

[Mr. Thomas Purse, for eleven years has been Superintendent and Secretary of the Savannah Board of Trade. Prior to that, for ten years, he was associated with the Antwerp Naval Stores Company. In his official position he has become well acquainted with market conditions and customs and has won recognition for his grasp of all commercial matters relating to Savannah.]

Naval Stores Boards at Savannah Board of Trade, March 31, 1920. Closing Day of Naval Stores Season. Supt. Purse Posting the Day's Transactions.

THE objects of the Savannah Board of Trade are to advance the commercial, industrial and civic welfare of the city of Savannah, to aid in the conservation and advancement of the business and professional interests of the city of Savannah and the state, to foster and encourage agricultural development of the trade territory of the city of Savannah and to bring into closer union and co-operation the people of this section; to establish and maintain in the city of Savannah a general Exchange and Board of Trade where the conditions of other markets and ruling quotations at such markets shall be published; where all statistics and information which may facilitate the general trade interests of the various branches thereof in the city of Savannah shall be collected and disseminated for the benefit of its members; to establish just and equitable principles, uniform usages, rules and regulations, and to generally promote the interests of its members and to increase the fa-

cilities of trade and commerce of the city of Savannah.

The work of the Association is carried on under five principal divisions, called bureaus. The Naval Stores Department is a division of the Commercial Bureau, with full power and authority to select the names and titles of their several departments or committees, to select the officers thereof, and to adopt, alter, amend or modify their own rules and regulations; and such trade rules and regulations when so adopted shall be treated as rules and regulations of the Savannah Board of Trade.

The most important committee of the Naval Stores Department is the Quotations Committee. Said committee is composed of three factors and three exporters or brokers at the beginning of each fiscal year (April 1). One factor and one buyer or broker is appointed to serve for two months and one factor and one exporter or broker for four months, and one factor and one exporter or broker for six months. By this method one factor and one exporter or broker goes off the committee every two months and they are automatically replaced by one factor and one exporter or broker to be appointed by the Secretary of the Board of Trade. The chairmanship of the Quotations Committee rotates between the two branches of the trade, namely, factors and exporters, and shall be the oldest member of the committee.

The quotations as posted by the committee shall at all times reflect the true and actual condition of the market and be conservative.

There is no appeal from the decision of the Committee on Quotations. Their word being final and absolute they weigh well everything that might be of value in arriving at a true quotation as they have to answer to no one, and they do their duty fearlessly and with regard only to what is just and equitable.

In case the committee are unable to agree as to tone and price, the chairman of the committee shall call upon a factor and a buyer who are not members of the committee to settle the question, and if they are unable to agree, the chairman shall call upon another factor and another buyer until an agreement is reached.

Actual transactions between factors and buyers only are taken into consideration. Sales from a buyer to a buyer, from a buyer to a factor, or from a factor to a factor, or to a buyer from a buyer through a factor, are not permitted to be reported, or considered.

Trading in Naval Stores: Probably over 95% of the transactions in Naval Stores are consummated upon the floor of the Board of Trade within a very few minutes of the appointed trading hour. The method followed is the result arrived at after many years of experience in the marketing branch of the industry, and is as follows:

The factor, as representative of the producer, desiring to secure the best prices possible for his offerings, and in order that every buyer may have an opportunity of bidding for his daily offerings of rosin and turpentine, telephones a memorandum thereof, giving the number of barrels and grades, early each day to every buyer's office. Just before the appointed trading hour representatives of all the naval stores houses, factors, exporters or brokers, assemble in the trading room of the Board of Trade, and on a board especially prepared for the purpose, each factor posts his offerings of rosin and turpentine. As soon as the listing is completed, the totals are arrived at and bids called for by one of the factors chosen by the factorage group to act as its chairman. Any buyer who cares to bid on all or any part of the factors' offerings may do so by submitting a sealed bid designating the parcels bid upon and when all have been deposited with the factors' chairman, the bidding is declared closed and the chairman proceeds to open and read aloud the various offers. Bids are tabulated as read and each factor figures the offers and arrives at the highest bidder on his line and declares at once whether he accepts or rejects. The right is reserved to reject bids if unsatisfactory and a factor may carry over his stuff unsold and take his chances on securing a better offer later on. As quickly as acceptances are declared, sales are tabulated and posted. When the quotation committee deliberates and arrives at a tone of the market and the prices to be quoted the chairman of that committee then instructs the clerk as to the official market which is immediately inscribed upon the blackboard. Only transactions between factors and buyers are recognized by the Quotations Committee and all possible effort is exerted to prevent the posting of sales which do not represent the actual market condition.

The tones of the Savannah market have the following significance:

STRONG—Very active with demand for all offerings at advancing prices.

FIRM—Where all offerings are or could be sold at prices reported.

STEADY—A part of receipts taken and a slightly lower price bid for balance and refused.

QUIET—Where only a small part of offerings are sold and balance carried over without bids or with much lower bids.

WEAK—Where transactions are made at rapidly declining prices.

DULL—Practically no demand, majority of offerings unsold and a portion sold at a decline.

NOMINAL—Where prices do not reflect true conditions.

NOTHING DOING—Absence of transactions for a period sufficient to demonstrate that there is no reasonable basis on which to post quotations.

BID AND ASKED—To be used when deemed necessary to reflect true conditions.

Among the rules governing trading are the following:

All sales are for cash on delivery, and unless otherwise agreed upon, all bills shall be due and payable on the second business day succeeding the day on which bill is rendered. The buyer shall have the right to demand that the delivery order shall be certified.

A better article shall constitute a good delivery on a contract for inferior goods.

The risks on property insurable under a fire policy shall remain with the seller until the bill is paid.

Payment of no bill shall be demanded before the produce is in order and ready for delivery.

The purchaser shall not be required to take any package of produce which is not merchantable under these rules.

To constitute a proper rendition of a bill for produce sold: The bill shall be delivered at the office of the purchaser by or before the hour of 6:00 p. m.

Settlement of contracts shall be based on fifty net gallons per barrel of turpentine and five hundred pounds per barrel of rosin.

Standard samples of spirits of turpentine and rosin as approved by the Committee on Inspection, and stamped as follows: "Approved by the Savannah Board of Trade," must be procured and kept constantly on hand in the Association rooms in some safe and suitable place; the samples of rosin to be renewed every two months; or oftener, if necessary, and every Inspector of Naval Stores must apply to the Inspection Committee for approved type samples at last once in two months, or oftener, if necessary, and pay cost of same. (It is understood and agreed that types of rosin and turpentine in use at the present time shall be used until other types may be approved.)

All sales of spirits of turpentine not otherwise specified shall be understood as in merchantable order in yards.

Spirits of turpentine shall be put in merchantable order by the seller, and the necessary cooperage shall be done by him until the evening of the first day after the rendition of the bill, unless previously removed; after which the leakage and expense of cooperage shall be at the risk and expense of the purchaser. The buyer shall be notified by 12 o'clock M. when the barrels are open for his inspection, and for that purpose the bungs shall remain out until one hour before sunset, and if not examined by the purchaser shall then be re-bunged, and if the purchaser shall, after this, desire to examine, it shall be at his own expense for opening and re-bunging.

Before delivery all turpentine barrels shall be filled to within one gallon of their capacity, and the purchaser there-

of or his agent, may examine same, and have the right to reject as unmerchantable any barrels which do not come up to requirements as stated in these rules; also all poor, mis-hapen or ill-made barrels; all barrels having any red oak staves or poplar heads; all barrels which are sweating or leaking at the time of examination; all converted whiskey barrels; all barrels containing water, dissolved glue or any other foreign substance, or on which the glue coating is found to have softened.

To constitute a good delivery there must not be any parcel or lot over 10% of colored turpentine. The deduction on colored turpentine shall be 2½c per gallon for one shade and 4c for two shades; any turpentine darker than two shades shall not be considered merchantable. In case of colored turpentine being tendered for standard turpentine, the buyer has the right to reject same and claim standard turpentine immediately in place of said colored turpentine, and the seller in the case of such rejection shall either substitute standard turpentine, or bring the rejected goods up to standard color. The buyer shall have the right to withhold payment of invoice until the goods have been put in merchantable order by the seller, which if not done within a reasonable length of time will be sufficient cause for the buyer to cancel the transaction, if he so desires.

Barrels, new or second-hand, must be well made, holding from 48 to 54 gallons, gross; staves must be of white oak, and shall be equalized thirty-four (34) inches long, and to be, when thoroughly dry and dressed, three-quarters (¾) of an inch thick, evenly sawed, and of uniform thickness throughout. Staves to be well seasoned, free from seed holes, cat faces, knots, shakes and rotten sap. Proof or wood-want not exceeding six (6) inches in length nor one-eighth (⅛) of an inch in depth will be permissible. Bung staves to be not less than four (4) inches nor more than five (5) inches in width, and bung holes to be bored in the center of staves, and grain of the heads to be in line with the bung stave. Heads to be of thoroughly seasoned white oak or white ash, and to be free from seed holes, cat faces, knots, shakes and rotten sap. White oak heads to be three-quarters (¾) of an inch to one (1) inch, and white ash heads to be fifteen-sixteenths (15/16) of an inch to one (1) inch in thickness when dressed.

Barrels to have six (6) steel hoops, as follows: Two (2) head hoops, 1¾ inches wide, No. 16 gauge. Two (2) quarter hoops, 1¾ inches wide, No. 16 gauge. Two (2) bilge hoops, 1¾ inches wide, No. 16 gauge.

All spirits of turpentine barrels to be tested with a good grade of commercial glue, when made, and must bear name of maker legibly stamped on same, also name of shop where made, and month and year of manufacture.

All barrels to be given at least two good coats of glue and one coat of Spanish brown paint on each head by the operator, and when filled, the bungs shall be tight and well glued in.

Refined petroleum, gasoline and/or naphtha barrels (provided they are not converted whiskey barrels), which have been properly steamed and glued, shall be a good delivery on sales or contracts, provided that such barrels are in merchantable order and are subject to a deduction of one-half cent per gallon. Such barrels with spile holes, except one in the bung stave, are unmerchantable.

Buyers may examine and test the accuracy of gauges and quality, and any ascertained difference in quantity or quality shall be rectified.

Before gauging, the hoops of every barrel shall be well driven.

All sales of rosin, not otherwise specified, shall be understood as in merchantable order in yards, Savannah weights and samples, with privilege to buyer of unexpired storage.

To be in merchantable order:

Barrels must have two good heads not exceeding 1¼ inches in thickness, the top head to fit close and to be well lined.

Staves shall not exceed 1 inch in thickness and shall be from 33 to 40 inches in length. All staves, however, in any individual barrel to be of uniform length.

One iron hoop on each head 1 to 1¼ inches wide, No. 16 gauge, and one iron hoop on each bilge 1 to 1¼ inches wide, No. 16 gauge, all hoops properly riveted; that is to say, four iron hoops on every barrel.

Barrels to be made on 22-inch head and 24-inch bilge truss hoops.

All barrels to be properly filled with rosin. (A properly filled barrel should have a chime of about 1 to 2 inches after head is in place).

Rosin shall be bought and sold by the barrel of 280 lbs. gross and shall be weighed on five (5) pound notches of scale beam, the pounds between 5 pound notches to be thrown off and proper allowance to be made for green timber, moisture, and adhering dirt, and every barrel shall have its weight and grade distinctly marked on it. Inspectors must also make proper deductions in weight on all rosin where staves or heads are thicker than is prescribed in Rule 2. Said deductions to be noted on certificate.

All rosin shall be weighed before sampling and coopering.

Buyers may examine and test, at their own expense, the accuracy of weights to the extent of 10% of any lot, and any error thus ascertained shall be corrected by the reweighing of the lot by another Inspector, at the expense of the seller.

All samples shall be seven-eighths of an inch cube, and taken from at least six inches from the surface of the rosin, and the grading made to conform to the types approved by the Savannah Board of Trade.

Inspectors in addition to sampling at least 90% at the top heads shall sample at the bottom heads at least 10% of each mark of rosin received and the samples so taken from the bottom heads shall determine the grade of the barrels so sampled at the bottom heads. Should such sampling disclose any barrel false packed, through error or otherwise, or any barrel containing dirt, trash, or other extraneous matter of sufficient quantity to make it unmerchantable, the inspectors shall examine the entire lot at bottom heads as well as top heads for false packed, mixed packed, or, as above, unmerchantable rosin. The expense of such examination and subsequent putting of unmerchantable packages into merchantable condition shall be borne by the seller. Barrels containing two grades divergent more than one grade, or containing three or more grades, shall be considered mixed packed and shall be marked with both the highest and the lowest grades, both grades to be given in the certificate of inspection and samples of both grades to be exhibited in the pans as offered for sale. Such barrels shall be sold on their merits without reference to either grade, but if there is no special agreement, settlement shall be made at the price of the lowest grade.

Where rosin is not properly strained, is specky or dirty, or contains extraneous matter, such condition shall be designated on barrels and on both original and duplicate certificates by the use of a circle enclosing the grade where poorly strained, and by the additional use of an "X" where badly strained, dirty or specky.

The Supervising Inspector of Naval Stores is requested to see that this rule is carried out, and if it is proven that any Inspector fails to examine 10% at bottom head and furthermore, when any false packed, mixed packed, or as above, unmerchantable rosin be found in this 10%, and Inspector fails to examine entire lot at bottom head, it shall be sufficient cause for request by this Association to City Council to revoke said Inspector's license.

Buyers of sampled rosin may examine the same at bottom and top heads, at their own expense, prior to removal. Should such examinaton by buyer disclose any barrel or barrels containing dirt, trash, or other extraneous matter to an extent warranting rejection, said buyer shall have the right to bill the seller with 25c per round barrel for each and every barrel so found. It shall then be the duty of seller to, at his expense, have such barrels cleaned out and reweighed, making settlement with the buyer on difference in weight. One full grade difference to be allowed between bottom and top heads. After removal no claim to be allowed, except in case of fraud.

As the quality of rosin does not deteriorate by exposure to the weather, rosin once inspected, the appearance of which has been changed by exposure to the weather, shall be considered merchantable according to the original grading.

SAVANNAH AS A NAVAL STORES PORT
1875-1920

(By Thomas Gamble)

"Two decades and less ago the visitor to Savannah found no more interesting sight than the Naval Stores Yards with turpentine in casks and rosin in rough barrels stretching away almost as far as the eye could see, and square rigged sailers of many nationalities taking on cargoes"

NO OTHER naval stores port has ever acquired or can hope to acquire the pre-eminence that Savannah obtained as to receipts forty years ago and easily maintained for thirty-five years. No other naval stores port likewise can ever hope to have and to hold the premiership as the market on which the eyes of the world center when naval stores prices are under consideration. To it for four decades has fallen the honor of fixing the quotations at which both spirits turpentine and rosins are posted in all the markets of the world. For forty years in the market columns of the leading newspapers the Savannah prices as to these commodities have appeared, and on the quotation boards of Chambers of Commerce at great trading centres they have been posted and studied as the infallible guide as to market conditions. To have been the unrivalled leader in a great industry in this way for so long a period is no mean honor and today, while Savannah's banner has been lowered as to the volume of receipts, its flag still floats bravely above all competitors, representing the one market whose quotations are universally recognized as the standard. Why it has been able to keep its prestige in this respect while its receipts have declined from year to year is told elsewhere, and is an interesting commentary on the part that experience and reputation play in holding a position of supremacy when adverse conditions otherwise threaten and tend to destroy it.

Many, many years before Savannah became the leader of the naval stores industry there were scattering shipments of pitch and tar through this port. But it was a very minor element in the commerce of the port, fast forging to the front in cotton shipments and in the handling of general merchandise. Several hundred miles to the north Wilmington was the centre of the naval stores trade, although at no time did its receipts anywhere near attain to the magnitude of the vast volume that subsequently passed through this port. For many years prior to the War Between the States and for several years thereafter, Wilmington was always quoted in the daily papers, Charleston for a time likewise enjoying that distinction but never approaching in public interest the port above it or the position afterwards accredited to Savannah. At Savannah the trade had not reached a sufficient magnitude to apparently justify the only daily newspaper of the city in quoting the local market for rosins and turpentine until 1874, at which time there seems to have been but one distinctively naval stores merchant in the city, commission merchants otherwise simply handling such lots as came to them from the interior without seeking the development of the industry in Georgia. Ketchum & Co. had established themselves here in that year as naval stores dealers and brokers and four years later (1878) proudly advertised themselves as "the oldest house in the city" in that line and as "filling orders for fine rosins

and spirits turpentine a specialty." The values of those first days of the industry in Georgia are shown in these quotations of 1874: Turpentine, 31 cents; E rosin, $2.10; F, $2.25; K, $5.00. The market on April 1, 1877, was: Turpentine, 33½ cents; WG, $4.50; N, $4.00; M, $3.25; K, I, $2.75; H, G, $2.20; F, E, $2.00; D, B, $1.80. B D was then posted as strained rosin, while E F were popularly known as No. 2, G H as No. 1, I K as pales, M as extra pale.

In the last five years of that decade, though, (1875-80) the production of rosins and turpentine in the territory tributary to Savannah began to assume a hitherto unknown importance. Daily receipts began to be chronicled and domestic and foreign shipments of those commodities frequently appear among the freights moving from the port. It was the period of eager expectancy that preceded the tremendous expansion that came with the early eighties and had its final culmination in the nineties. In 1875 enough interest was felt in naval stores, and their receipts had become sufficiently important, to justify an informal association of those engaged in handling them for the purpose of posting prices as an accurate reflection of trading values and of keeping statistics. It was not until July, 1882, though, that the Naval Stores Exchange came legally into being, securing its charter from the Superior Court, and for the first time giving to the Savannah market an official position before the world. The market columns of the newspaper show that for the year 1875-76, the first season that statistics were compiled, the receipts were 10,348 barrels of turpentine and 53,060 barrels of rosin, an aggregate of 63,408 packages, and it was evident to even the casual observer of business matters that naval stores were henceforth to be of increasing importance in the city's commerce and bring it into closer trade relations with the world at large. Two factorage houses were soon established, forerunners of the heavily capitalized concerns that before long were to finance naval stores operations in three states.

The pine forests to the north of Georgia were rapidly becoming exhausted. Once they had been regarded as the source of unlimited supplies forever. As the long leaf pines had been swept from the Carolinas there had come a tremendous expansion in the diversity of uses for turpentine and rosins, more particularly the latter, which but a comparatively few years before had been a waste product and practically unmarketable as regards the lower grades. Demands were created the volume of which grew by leaps and bounds from year to year. Probably few American industries have found so great an increase in the uses to which their products are put as fell to the lot of naval stores in the thirty years from 1880 to 1910, the period when the industrial life not only of the United States but of many foreign lands was undergoing a tremendous development. The increasing requirements of consuming industries forced increasing supplies and the naval stores industry bulged southward across the Savannah river into the great virgin pine forests that four decades ago still covered a large part of Eastern and Southern Georgia. An almost unbroken pine belt stretched westwardly and southwestwardly from Savannah to the Alabama line. This empire became the seat of the naval stores industry and from it came the enormous quantities of rosins and turpentine that found a market all over the globe. These forests have today largely disappeared, swept away by the sawmill men following close in the wake of the turpentine men, and fertile fields and prosperous towns and villages greet the eye in their place. It has been the natural onward movement of the race toward the higher and more comfortable and more varied, even if more prosaic, civilization, but one cannot but breathe a sigh of regret for the millions of acres of noble trees that have disappeared, bringing back many claim but a minor stream of gold in replacement, for the industry passed through many years when the returns were in nowise commensurate with the efforts put forth and the great raw wealth that was swept away.

Like the Biblical heroes of yore, the operators of the "Old North State" espied the promised land and treked southward to the unbroken woods of Georgia. One after another they came. A few established themselves at Savannah as factors for the industry. These were practical operators turned capitalists, men with means adequate to advance the financial needs of the producers and prepared to satisfactorily handle their products when shipped to market. Hundreds of the producers came with the years to open up turpentine farms, to box the trees and put the negro hands to work. For many years these laborers were direct importations from North and South Carolina. Only a few years had passed when a small army were at work in all directions and turpentining had become an important industry from the Savannah river clean west to the Chattahoochee, with a few more venturesome spirits passing over that stream into the forests of Alabama, forerunners of the pioneers who in later years invaded the virgin forests of Mississippi, Louisiana and Texas. It was an era of pioneering development. New railroads reached out into the unbroken woods and a veritable flood of naval stores began to pour into the port of Savannah. Square rigged sailing vessels, now so seldom seen, crowded its wharves, and the Norwegian, Swedish, German, Spanish, British, Italian and other flags above them told of the varied nationality of the carriers that were transporting rosins and turpentine to Europe and other continents. The banking business of the city was swollen by millions of dollars a year. On April 1, 1882, in briefly reviewing the season just closed, the Savannah News declared that "The whole outlook is very fine and with no untoward circumstance the season upon which we enter today promises to be, if possible, more successful than the past. In regard to receipts at this port we will largely widen the distance between us and Charleston and make a heavy stride toward overtaking Wilmington, heretofore the first American port." This prophecy was speedily borne out Savannah quickly assumed its position as the first naval stores port of the world. By the season of 1882-83 the receipts showed a gain of 600 per cent. in eight years. It was then that the Board of Trade began its long and honorable career, that body dating back to June, 1883, from which time it has been the centre of the trade and the custodian of statistics pertaining to the local movement of naval stores. Its organization was the immediate outgrowth of the public spirit of the naval stores factors and dealers. As its president said in his first annual report, "The Naval Stores Exchange, by unanimous consent of its members, amended its charter and altered its name to the Savannah Board of Trade, a change which has proven its wisdom in extending its usefulness to nearly all branches of business in the city, and gives promise to benefit the community at large." That year, the first of the history of the Board of Trade, receipts of naval stores jumped to 697,-165 packages. "Twelve years ago," said the president, "a barrel of rosins or spirits of turpentine was scarcely known to this market, while today Savannah is known as the largest naval stores market of the world." The trade in naval stores at the port that year was estimated at $4,000,000. To the Board of Trade in a large measure has been due the position of general and continued influence the naval stores trade of Savannah has since occupied. Through its instrumentality inspection laws have been secured and enforced and every possible protection thrown about the industry. Through it the standards of quality and of grade were made official and permanent and its position as chief spokesman for the entire trade of the South after thirty-seven years remains unimpaired and unchallenged.

The season of 1891-92 for the first time brought a million barrels of naval stores

to Savannah, 1,108,664, to be exact, and on the day the 1,000,000 package record was attained a great white flag bearing those figures was flown above the building in which the organization was then housed and a few bottles of champagne were opened—national prohibition was not then dreamed of—in honor of the event. But much greater records were to be made and for eleven subsequent years the total for 1891-92 was eclipsed so that a million barrels became a mere commonplace. Twenty-one years after the organization of the industry, Savannah's receipts of naval stores had grown from 63,408 to 1,640,495 barrels, the largest volume ever handled at any port in the history of the industry, an increase in the two decades of 1,577,087 barrels, or 2,487 per cent. The market value of Savannah's greatest year's receipts was approximately $10,000,000. That season saw the peak of production reached in the Savannah territory. For several years it remained fairy stationary and then the effects of the onslaughts on the forests became apparent and Savannah's receipts began to fall off, the opening of Jacksonville as an actual competing market in 1903 still further reducing the offerings here. Never again, in the history of the world, in all human probability, will any port equal the astounding record made at Savannah in that season of 1896-97. Compared with its handlings then of 1,640,495 barrels of naval stores we have the height of the movement through Jacksonville, 654,508 barrels in 1916-17, and 314,402 through Pensacola in 1914-15. Cotton and corn and oats and peaches and melons now grow where the lordly pines of Georgia once held proud dominion and new sources of wealth have come from the soil cleared of the timber that until the coming of the turpentine operator with his axes and his hacks had been veritably a drug on the market and a source of infinite labor to the settler clearing the land for a homestead.

In April, 1875, the stocks at Savannah were found to be 8 barrels of turpentine and 732 barrels of rosins. It was a far reach from those extremely modest figures to the tremendous stocks that filled the immense terminals fifteen to twenty years later, by which time it was no uncommon thing to find under the sheds as much as 35,000 to 40,000 barrels of turpentine and in the yards 150,000 to 200,000 or more barrels of rosin. The greatest stocks on any one day at Savannah, the greatest in the history of any port, were probably 281,055 barrels of rosin on January 18, 1897, and 63,255 barrels of turpentine on August 2, 1894. To handle such vast quantities as poured into the port over their lines required heavy expenditures by the railroads for storage facilities and there was no stint of space or of money to provide for the freights that for so many years bulked so largely in the business of the lines having their terminals at Savannah. Two decades and less ago the visiting stranger to the port found no more interesting sight than the naval stores yards with turpentine in casks and rosins in rough barrels stretching away almost as far as the eye could see. Today the yards have shrunk in keeping with the diminished traffic in these commodities. Tanks came in due season to relieve the congestion as to turpentine and provide more secure methods of storage and two competing companies with six tanks now offer accommodations for the satisfactory handling of 30,000 casks or 1,500,000 gallons of turpentine. The sailing vessel is now seldom seen taking on a cargo at the wharves, their use during the world war having been a purely temporary expedient. Tramp steamships carrying full or part cargoes now handle the vast bulk of the foreign movement from this and other ports, while the regular coastwise steamship lines move large quantities to the northern ports either for home consumption or for shipment to foreign countries.

The pine trees of Georgia and Florida and Alabama brought fortunes to many among the factors and operators. There is a feeling, more sentimental than practical, that this section gave away its heritage in the sacrifice of its forests and the sale of its timber, and lumber and naval stores at low values. It is true that in some seasons the financial returns were unsatisfactory. But the states in question could not remain a wilderness of pines. The advancing wave of humanity demanded homes and the fact that while the lands were being cleared thousands and tens of thousands derived a livelihood from turpentining and saw milling, while many acquired a comfortable competence and some large fortunes, and that the wealth thus derived was used for the upbuilding of this section in railroad construction and in agricultural and industrial development, compensated for this passing of the pine. When the turpentine man came to Georgia it had a population of 1,200,000. Today it has a population approaching 3,000,000. The naval stores industry may well be said to have done its part in making this growth possible.

The following tables give a complete view of the development of Savannah as a naval stores port, its fluctuating receipts over forty-five years, and its relation to the total production and to foreign shipments of rosins and turpentine. The receipts are gross. From year to year some quantities of naval stores seeking a better outlet than afforded elsewhere, have come to Savannah after being received and inspected at Brunswick, or Jacksonville, or Pensacola. Generally these are a very minor element, but last season these receipts from other ports aggregated 29,755 barrels turpentine and 23,464 barrels rosin. This year (1920) Savannah's receipts show a remarkable increase in percentage and it is evident that its superior facilities are drawing to it a larger proportion of the crop of the Southeastern producing territory.

PERCENTAGE OF SAVANNAH'S NET RECEIPTS TO APPROXIMATE TOTAL PRODUCTION.

Season.	Per Cent. of Spirits Turp.	Per Cent. of Rosins.
1919-20	14	15
1918-19	14	16½
1917-18	16	17
1916-17	16	18
1915-16	18	22
1914-15	24	24
1913-14	30	29
1912-13	30	31
1911-12	32	33
1910-11	31	32
1909-10	30	34
1908-09	32	35
1907-08	30	32
1901-02	46	48
1899-1900	41	44
1879-80	10½	22

SAVANNAH'S GROSS RECEIPTS OF NAVAL STORES.

Season ended March 31.	Spirits Turp. Casks (50 gals.)	Rosin Bbls. (500 lbs.)	Ttl. No. Pkgs. Rec'd.
1919-20	88,910	223,239	312,149
1918-19	48,088	185,763	233,851
1917-18	89,675	326,754	416,429
1916-17	102,837	413,481	516,318
1915-16	109,348	403,352	512,700
1914-15	138,145	459,587	597,732
1913-14	202,019	652,794	854,813
1912-13	216,534	747,549	964,083
1911-12	208,981	724,395	933,376
1910-11	171,689	612,249	783,938
1909-10	174,346	625,032	799,378
1908-09	238,143	834,800	1,072,943
1907-08	205,068	720,095	925,163
1906-07	194,702	665,102	859,804
1905-06	206,269	702,654	904,923
1904-05	175,531	617,617	793,148
1903-04	193,647	650,938	844,585
1902-03	292,496	940,507	1,211,177
1901-02	314,346	1,071,440	1,384,475
1900-01	337,452	1,119,957	1,457,409
1899-1900	309,465	1,076,815	1,386,280
1898-99	329,466	1,123,942	1,453,408
1897-98	313,797	1,127,120	1,440,917
1896-97	329,445	1,311,050	1,640,495
1895-96	303,867	1,143,020	1,446,893
1894-95	268,259	993,164	1,261,423

1893-94	261,080	957,027	1,218,107
1892-93	277,617	1,032,198	1,309,815
1891-92	234,986	873,678	1,108,664
1890-91	196,166	758,448	954,614
1889-90	183,558	683,077	866,635
1888-89	158,208	584,428	742,636
1887-88	169,961	643,532	813,493
1886-87	147,352	582,539	729,891
1885-86	107,369	450,106	557,475
1884-85	117,291	478,834	596,125
*1883-84	133,139	564,026	697,165
1882-83	89,319	391,006	460,325
1881-82	55,578	252,364	307,942
1880-81	51,443	266,847	318,290
1879-80	37,119	192,687	229,806
1878-79	32,880	184,236	217,116
1877-78	24,732	156,001	180,733
1876-77	15,091	78,268	93,359
|1875-76	10,348	53,060	63,408

*Savannah Board of Trade organized from the Naval Stores Exchange, June, 1883.

|| Year of greatest receipts at Savannah. The gross receipts, including stuff reshipped here from other ports, were 1,640,495 barrels.

| First year statistics were kept.

FOREIGN SHIPMENTS FROM SAVANNAH AND PERCENTAGE AS TO TOTAL EXPORTS FROM THE UNITED STATES.

Spirits Turpentine.

Season.	Exports Spirits Turp. Casks. (50 gals.)	Per Cent. of Total Exports.
1919-20	56,744	27
|1918-19	10,901	13
1917-18	12,702	12
1916-17	43,333	22
1915-16	65,646	34
1914-15	72,046	30
1913-14	152,476	40
1912-13	142,329	33
1911-12	111,375	31
1910-11	85,374	30
1909-10	99,529	31
1908-09	133,687	35
1907-08	108,108	32
1906-07	85,726	27
1905-06	105,334	33
1904-05	71,066	21
1903-04	97,830	29
1902-03	216,109	51
1897-98	214,395	62
*1896-97	261,841	75
1877-78	2,978	02
1876-77	None	....
||1875-76	None	....

Rosins.

Season.	Exports Rosin Bbls. (500 lbs.)	Per Cent. of Total Exports.
1919-20	73,880	15½
|1918-19	60,180	15
1917-18	53,007	07½
1916-17	146,001	15
1915-16	170,392	20
1914-15	273,716	33
1913-14	378,981	26
1912-13	324,611	23
1911-12	327,805	23
1910-11	308,557	24
1909-10	362,569	31
1908-09	413,269	27
1907-08	340,046	23
1906-07	333,310	23
1905-06	300,153	22
1904-05	223,477	15
1903-04	326,573	23
1902-03	504,173	34
1897-98	862,717	61
*1896-97	852,142	69
1877-78	31,320	05
1876-77	8,570	01.6
||1875-76	7,333	01.6

| Savannah's year of smallest receipts in twenty years.

*Savannah's year of largest receipts.

|| Year statistics were first kept.

THE OLD SAVANNAH NAVAL STORES EXCHANGE

(By Spencer P. Shotter.)

[For over thirty years Mr. Spencer P. Shotter, now of New York City, was one of the most prominent figures of the naval stores world; for a number of years he was a dominating element in the domestic and international trade in these commodities as head of the S. P. Shotter Company, and then of the American Naval Stores Company. One might say without exaggeration that wherever rosins and turpentine were produced, dealt in or consumed, the name of Mr. Shotter was familiar. It is doubtful if any one will ever again hold the commanding position acquired by him.]

I ARRIVED in Savannah in April, 1879, from Wilmington, N C., where I had acquired some experience as a buyer or exporter. I rented an office in the Kelly Building next to the City Hall, and spent the summer looking over the land of promise, as the general feeling was that the production of turpentine and rosin was marching into Georgia. I found doing business as factors, the firms of Parker & Jackson, Peacock & Hunt, and C. L. Jones, while the buying was done principally by H. Fraser Grant, representing Paterson Downing & Co., of New York, and the old established house of A. Minis & Son, who represented the interests of a large New York firm. Paterson, Downing & Co. put up their own sign a year or two later, and about that time A. Minis & Son lost interest in what was regarded as "only a summer business anyway," as the winter receipts were negligible. I must mention here my old friend, T. T. Chapeau, who was very active as a broker for New York as well as local accounts. He was a very genial and kind-hearted character, universally liked and most successful in his line. He is to be added to the list of buyers, so the factors usually found an active demand for their daily receipts.

The samples came up at night and were held over until morning, and, when the demand was exceptionally sharp, a rule was established that the first comer had priority in barbershop fashion, so that it was a common sight to see three or four buyers sitting in a factor's office, awaiting his arrival at eight o'clock in the morning--the factor would then make up his asking prices, always "in lines" and the first comer had the first chance of accepting. The practice of selling "in lines" worked wonderfully well for the factor, as it enabled him to render account sales without delay, and greatly increased the number of buyers, for one might wish to buy low grades and another be interested only in pales. This "hardship" on the buyer frequently resulted in no business being done for some days and occasionally a factor would break the rule and sell "H and below" or "I and above."

It must have been early in the "eighties" when Williams and Watson came along as factors and into this firm shortly after came my old comrade Mr. J. A. G. Carson, who may be properly called the Dean or oldest active member of the naval stores business of the present day. He has witnessed the changes from boyhood if not from infancy to the full manhood of the present and always keenly at the front.

But without any rules to govern our trading, there was lack of uniformity. Terms were made to suit the degree of anxiety of the factor to sell, and no rules with regard to delivery. At first the railways received the turpentine and rosin, discharging the goods into the fields, keeping no records and charging no storage. My own customers were mostly in the Middle West, and it took nearly a year to arrange freight rates beyond Atlanta. In fact, the old-time freight agent of the Central Railroad became very hostile towards me for asking for a through bill of lading to Chicago, with rate to Atlanta only. Fortunately I soon made his acquaintance on a week-end fishing trip and we became very friendly. After that it was only necessary for me to bring a lot of bills of lading to him, and hear him say: "All right, Shotter, if you say the stuff's there I'll sign these papers, and count the barrels when the sun is not so hot."

Misunderstandings often arose, bickerings and hot blood not infrequent, so that, in the absence of anyone to contradict me, I may say that I suggested that all buyers and factors meet together and organize a Savannah Naval Stores Exchange, something along the lines of the Cotton Exchange, with officers, directors and committees, which could make uniform rules and enforce them. I was backed in this by Peacock Hunt & Co., who were wise in their age, so we all met in a room on the second floor of the office building adjoining the present Cotton Exchange (not built at that time). Everything was harmonious. We elected a Board of Directors with Mr. C. S. Ellis, a junior partner of Peacock, Hunt & Co., as president. He was an excellent selection, but retired (like G. W.) at the end of his second term. Just then an amusing incident occurred, which put me where I belonged. The annual meeting was held without any previous caucus, and because I was always aggressive and actively interested in the aims of the organization, I was elected President. That caused a sensation among the factors, for of course our interests were not always identical, and I was very insistent on what I considerd to be my rights. During the preceding two years the factors had brought in as members, many of the jobbing trade, to whom they gave their patronage—not at that time having supply houses of their own. These jobbers being personally friendly to me, voted for me quite innocently—but immediately after the election I found I was the last man anybody wanted. A new election was threatened and I saw that I was in for a bad time, if not liable to be kicked out. To spare all of this, I advised with some of my friends and arranged to decline the distinction offered, in favor of my life-long friend, Mr. J. K. Clarke—at that time a very active and prosperous timber merchant of the city. This was unanimously satisfactory. The devil was disposed of (the only charge against me, however, being my youth) and we had secured as a President the man, who in my opinion, was the best executive the Exchange, or its successor, ever had. He served for several terms, for all alike recognized his clear mind, and sense of fairness. As he was in no way connected with the naval stores business, he was particularly satisfactory to our fraternity.

THE SAVANNAH BOARD OF TRADE, GUARDIAN OF NAVAL STORES INTERESTS

(By Thomas Gamble)

THE Savannah Naval Stores Exchange after working for several years without a legal status, applied for and received its charter at the June, 1882, term of the Superior Court of Chatham county, Ga. Its incorporators were Messrs. T. T. Chapeau, C. L. Jones, J. P. Williams, J. W. Hunt, S. P. Shotter and W. C. Jackson. Of these there survive (1920) but two, Mr. Shotter and Mr. Jones. The Exchange functioned under its charter but one year. At the next June term of the court it was amended, the name of the corporation being changed to The Savannah Board of Trade. The Exchange was incorporated as a stock company, each member being a shareholder, a system which was continued under the amended charter. The charter privileges were granted for twenty years, expiring in 1902. The organization had the right to sue, could be sued, and otherwise possessed the powers and privileges usually granted to corporations.

When the period for which the charter had been granted expired the fact was overlooked and it lapsed by limitation. For seven years The Savannah Board of Trade continued its work as a stock organization, blissfully ignorant that it had no charter and that it had been transformed into the largest private partnership in the city or State, with scores of members, representing some of the heaviest financial interests of the city, all liable for any judgment that might have been secured in the event of a suit. It was not until the election of Mr. J. A. G. Carson as president in 1909 that the omission of renewal of the charter was discovered by him. Without any publicity of the fact it was proposed and arranged that a new charter should be secured as the Savannah Board of Trade, with the proviso that "Said Association not being organized for pecuniary gain the same will have no capital stock." On July 23, 1909, the new charter was approved and the organization began life as a voluntary body of dues-paying members without stockholding being requisite for admission.

For thirty-seven years the Board of Trade has well fulfilled its objects as set forth in the charter, to-wit:

"To establish and maintain in the city of Savannah a general Exchange and Board of Trade where the conditions of other markets and ruling quotations at such markets shall be published; where all statistics and information whch may facilitate the general trade, inclusive of the various branches thereof in the city of Savannah, shall be collected and disseminated for the benefit of its members and such other persons to whom said Board may extend such privileges; where such members and such other persons to whom such privileges may be extended may meet for the exchange of views and the transaction of business; and where all matters and things within the legitimate scope of said Association may be attended to; to adjust controversies between its members; to establish just and equitable principles, uniform usage, rules and regulations, and to generally promote the interests of its members and increase the facilities of trade and commerce of the city of Savannah."

While various other lines of trade and industry are largely represented in its membership and in recent years the scope of service of the organization has been widely expanded to include all departments of commercial activity, the Board of Trade has from its inception been peculiarly the guardian of naval stores interests. Its standing has been mainly that derived from its recognized position in the world of business affairs as the regulating and controlling force with regard to spirits turpentine and rosins. The United States government has acknowledged its peculiar status in this respect whenever questions have arisen in Congress or the Federal departments relative to such commodities, and the words of its spokesmen before committees and cabinet officers and other men of public influence and power have always carried a large measure of weight and influence. All of the legislation, State or national, relative to inspection of naval stores, standard grades of rosins, purity of turpentine, etc., had behind it the pressure exerted by the Savannah Board of Trade as sponsor for the welfare of a great Southern industry. There is today no apparent diminution of its influence and authority and little likelihood of its being shorn of them for many years to come.

The Savannah Board of Trade has been ably served by its directors and presidents, representative of the business interests affiliated with the organization. Its presidents have all been men of force and business standing, who have added to the prestige of the organization at home and abroad by their skilful handling of important questions arising during their administrations. The presidents since its charter was granted in 1883 have been as follows:

1883-84	H. Fraser Grant
1884-86	James K. Clarke
1886-88	Fred M. Hull
1888-90	John R. Young
1890-91	Isaac G. Haas
1891-1904	Daniel G. Purse
1904-06	John R. Young
1906-08	Wm. B. Stillwell
1908-12	J. A. G. Carson
1912-13	Harvey Granger
1913-17	J. Ward Motte
1917-18	W. V. Davis
1918-19	Geo. T. Cann
1919-21	Chas. G. Edwards

HOW THE PURITY OF NAVAL STORES IS PROTECTED

(By Harris M. King.)

[Mr. Harris M. King of Savannah, Ga., began his connection with the naval stores industry in 1876 as a distiller in the woods. In 1883 he became a naval stores inspector at Savannah and subsequently filled the same position at Brunswick, his connection with the trade in that capacity extending over twenty years. In May, 1910, he was appointed Supervising Inspector of Naval Stores for the State of Georgia, and has held the position until the present time, his term of office expiring in 1922.]

THE office of Supervising Inspector of Naval Stores was first instituted by the Savannah Board of Trade early in the year 1894. The adoption of the resolutions creating this office seems to have been the cause of discussion as the records show that the committee having this matter in charge had quite a number of meetings before final action was taken, which was doubtless required, owing to the importance of the question under consideration. All differences were finally adjusted, however, and the Board of Directors, in whom the appointive power was invested, appointed Mr. J. W. Hinson, one of the veterans of the business, as the first Supervising Inspector. The chief object of the office was to have a competent and impartial arbiter, in order that differences arising between buyer and seller, factor and producers, regarding weighing, grading, gauging, coopering, etc., could be settled in a satisfactory manner. He also had general supervision over the City Inspectors of Naval Stores, and it was his duty to investigate complaints which might be brought against them, and see that they did not neglect or slight their work in any way. The Supervising Inspector was, in fact, the court of last appeal, and his decision in any case was final. The office, which was purely a local one for the port of Savannah, served the purpose for which it was created for a number of years, or until the passage of the Georgia Act of August 17th, 1903, to which reference will shortly be made.

The low prices which naval stores operators were receiving for their products in the latter part of the nineteenth, and the first part of the twentieth century, had a most disastrous effect on the industry. Operators were working almost hopelessly against financial losses, and few indeed were able to wind up a year's work and break even, and none of them made any money. The ease with which a small amount of mineral oil could be mixed with a barrel of turpentine, was a temptation which not all of them were able to resist, especially as there was no law against their doing so at the time. Even then, it was the duty of the Supervising Inspector to make tests for adulterated turpentine, and if the adulteration was not too flagrant, no special objection was made by the buyers, and same was accepted and shipped, and singular to say, very few paint and varnish manufacturers registered any complaint against it. In some instances, however, the adulteration was so marked that the stuff would not be accepted, in which event it was either sold on its merits or returned to the operator, who would either have to reduce it by the addition of a quantity of pure turpentine, or re-distill it, as the necessity of the case might require. Letters of caution, warning operators to desist, were written time and again; but notwithstanding this the adulteration of spirits of turpentine with mineral oil continued, increased and thrived, until the trade realized that some decisive steps must be taken in order to prevent its continuation.

Early in the summer of 1903, a bill was introduced in the Florida Legislature, known as the "Pure Spirits of Turpentine Act," the object of which was to prevent and prohibit the adulteration of turpentine, and to provide for the appointment of a State Supervising Inspector of Naval Stores. This bill was passed and went into effect at once, and Mr. J. R. Parker, of Jacksonville, was appointed as Supervising Inspector of Naval Stores for the State of Florida.

The Georgia Legislature met in annual session very shortly afterwards, and a bill practically identical with the Florida law was introduced by the Hon. F. L. Sweat, of Douglas, the caption of which is as follows:

"AN ACT to prevent and prohibit the adulteration of Spirits of Turpentine and Naval Stores, and to provide for the appointment and the duties of the 'Supervising Inspector of Naval Stores,' and to prescribe forfeiture and penalties for violation, and methods for the enforcement of the provisions of this Act, and for other purposes."

This bill was finally passed and adopted August 17th, 1903, and Mr. Richard P. Register, of Savannah, was appointed as Supervising Inspector of Naval Stores for the State of Georgia. Thus was the State law against the adulteration of spirits of turpentine set in motion in the States of Florida and Georgia.

The effectiveness of the law as a means for preventing adulteration of spirits of turpentine has been fully demonstrated so much so in fact, that it has practically ceased, so far as being carried on by naval stores operators, is concerned; and for a period of more than five years not one single case of adulteration has been reported in either of the Georgia ports, Savannah and Brunswick; and analysis of samples taken from storage tanks, made by the Bureau of Chemistry, at Washington, showed that there is not a trace of adulteration found at either port. The samples taken from the storage tanks represent shipments of turpentine received from hundreds of operators located in the States of South Carolina Georgia, Florida and Alabama, who ship their products to the Georgia ports.

The purity of rosin, while not safeguarded in the same manner as turpentine, is properly looked after, nevertheless; and the records show that comparatively few complaints of false packed rosin are returned to the shippers from the Georgia ports. The law requires

that ten per cent. of all receipts of rosin must be examined in the bottom head, and should one barrel in the percentage show mixed, or false packed, the entire lot must be opened and examined in the bottom head, and cleaned out at the expense of the shipper.

The most important advance regarding the inspection of rosin, has been the adoption of the standard types prepared by the Bureau of Chemistry, at Washington. These standard types are made of red and yellow glass, the proportions of same being made to meet the requirements for the different grades they represent. Before any definite action towards preparing these types had been made by the Bureau of Chemistry, they secured samples of the glass direct from the makers, and sent same out to Savannah, and probably other places, to be tested as to durability of maintaining its color. The samples of glass for Savannah were put in the custody of Mr. J. A. G. Carson and the writer, and the test to which they were submitted was putting them where they would have all the various climatic exposures which our climate could afford. The glass in the custody of Mr. Carson was put where it was exposed to the rays of the morning sun, and my glass had the afternoon sun. This test was continued for nine months, after which time the glasses were sent to Washington to see whether or not there had been any change in color of same. The investigation and examination showed there was absolutely no change whatever in the color; but the test did not stop there; for they were returned back to us, and they went through another nine months test, which showed not the least variation from the original color. It was then that the first set of standard glass types, prepared by the Bureau of Chemistry, were issued, and used as an experiment by the Savannah inspectors. Open air grading with glass types is not entirely satisfactory, for the reflection in the glass in certain lights makes it impracticable, and they were, of course, found to be unsuited for everyday grading by inspectors.

All of the rosin types used in this country up to this period were prepared by Hiram F. Smith & Son, of New York; and in justice to them, I will say that the accuracy by which these standards were maintained was most remarkable; and types prepared by this concern were continued to be used, as it was more practicable to do so than to use the glass ones which had been prepared by the Bureau of Chemistry, especially as the latter had not been officially adopted.

Early in the year 1915 a convention was held at Washington, which among other matters under consideration by the naval stores trade, representing factors, producers, buyers and consumers, was the question of adopting the standard glass types, which the Bureau of Chemistry had been working on for some time past, and which were shown to be a considerable improvement on the first set which they had issued, as we all understood purely as an experiment. It did not take the committee long to see the advantage of having a permanent standard rosin type and they were adopted, as I recall, without a dissenting vote.

The first sets issued, however, were not entirely satisfactory; for instance, the WW and WG were entirely too close together, and the H and G were too far apart, which were the principal objections to them; but in all other respects, they were found to be, without question, the only practicable method for grading. The grading was not done with the types themselves, for they were used to match rosin types by, and it was the rosin types matched correctly with the glass standards that were used for all grading.

Early in 1916, another meeting was called for the especial purpose of revising the standards, and correcting and equalizing the variations between the grades, wherever they existed. This meeting was presided over by Mr. J. A. G. Carson, of Savannah, and was held in Washington, D. C. The committee appointed for making the revisions was composed of Mr. F. P. Veitch, of the Bureau of Chemistry, Washington; Mr. E. S. Cravens, Supervising Inspector of Florida; Mr. James F. Brailey, of the Yaryan Naval Stores Company, of Brunswick, Georgia; Mr. James T. Wells, one of the oldest of the Savannah naval stores inspectors; Mr. Harris M. King, Supervising Inspector for Georgia. We carefully studied the matter, deciding unanimously upon every correction and equalization which was made, and the standards issued at this meeting by our committee were universally adopted, and have been used ever since.

As stated in another part of this article, grading of rosin is not done directly with the glass standards, but with rosin types made up to match exactly with the standards. To do this correctly is extremely difficult, and it can only be done with a north light, and with the use of a tintometer, at the end of which is placed the glass standard and the rosin type which is to be matched. The tintometer in use by the writer is a combination of the one in use by the Bureau of Chemistry, and the instrument made by the Tintometer Company, and made to suit my own focal vision in length of same. I make all of my own instruments, and made one for the Bureau of Chemistry, by the design which was sent me for the purpose.

Practically all of the rosin types now in use the world over are made in Savannah, the New York concern of Hiram F. Smith & Son, having for the time discontinued this work; and it is a very important business, requiring the greatest care to correctly match and assort the various types, and prepare them for every day use.

The State law imposes upon the Supervising Inspector a general supervision of all the inspectors, naval stores yards, plants, etc., in the State, and it is his duty to see that no adulteration of turpentine, or alteration of grade marks on barrels of rosin, is done at any of them. There are other duties, not mentioned, but quite important, nevertheless; and that is to look after all the different makes of turpentine barrels coming into the ports under his jurisdiction, and test same for accuracy of holding and gauging capacity, and see also that the manufacturers are complying with the specifications regarding the quality of timber used in the manufacture of same, as well as maintaining the required standard in width and gauge of hoops, as set forth by the rules adopted by the Savannah Board of Trade. He must also test all scales by the standard scale provided for the purpose, used for weighing rosin; see that gauge rods and outsticks are correct and up to the required standards which are kept for the purpose. For the benefit of operators he is frequently called on to report upon conditions of shipments of rosin and spirits, and to make recommendations for bettering same.

The office of Supervising Inspector, which was originally started as an experiment, has proved to be valuable to the trade, and those who were at first doubtful as to the beneficial results of same, are now among its warmest supporters.

THE NAVAL STORES INSPECTOR--HIS WORK AND HOW HE DOES IT

(By John E. Register.)

[Mr. John E. Register is one of the most experienced naval stores inspectors in the South, having served in that capacity for thirty-four years, three years at New Orleans and thirty-one years at Savannah.]

WHEN cars containing spirits of turpentine come into Savannah, they are placed at the spirits shed, alongside of which runs a platform about the height of the car-doors.

The barrels are turned down, rolled out on this platform, and thence skidded to runways leading to sheds, which are large, airy structures, divided into numbered sections, enabling ready identification of the location of any lot.

The sheds are commodious, airy structures, designed with a view of caring for turpentine to best advantage.

As soon as a lot reaches its location, the barrels being placed bung up, the bung-opener with a steel spike removes the bung; and the inspector following him, places his hook in the center of the bung-hole, inserts his gauge rod, and measures the capacity of the package.

Correct gauging is a very delicate operation, and requires long experience to secure accurate results. The gauge rod, which is graduated and brass-tipped, must be thrust into the barrel at an exact angle, in order to strike chime at the right point, and the reading made where the stick and hook make a junction; the reading being taken from both ends of the barrel. The slightest deviation will cause a wide variation from the true gauge.

After barrels are thus measured, the inspector calls the gauge, which is immediately cut in the bung stave with a timber-scribe.

Next, a glass spirits-thief is inserted, and an examination of each barrel's contents made for color of water. The out-stick is then used to determine if barrels are filled to within one gallon of gross capacity, and if not they have to be packed up before delivery to buyer.

When delivery is made to buyer, his representative verifies the outs, barrels are bunged, rolled, and hoops driven to see that packages are in the proper condition, and those that show signs of leaks, broken staves, or dished heads are crossed out, and have to be turned or repaired.

As an inspector gauges, his clerk accompanies him, and as mark, lot, and gauges are called, he enters same on a certificate, which is checked and signed by the inspector. This certificate is used by the factors in billing, and a duplicate certificate is also made, on which packing, overs, numbers of barrels turned and repaired, if any, etc., appear, the duplicate being used in making returns to the shipper in the woods.

Rosin is discharged at rosin sheds, barrels being thrown down on sides, and different lots rolled out in drifts, the idea being to facilitate operations in weighing and inspecting, the lot number, the car number, and dates being marked on one barrel of each lot. The first process is weighing, which is accomplished by use of a special scale known in naval stores parlance as a rosin beam. The weighing crew usually consists of a weigher and five assistants; from the beam a grab hook is suspended, the scales are placed at the end of the drift, and are usually moved up as barrels are weighed and headed. The weigher calls the weight, and the marker with his brush marks weight and lot number on each barrel. Rosin is weighed on five-pound notches, and the odd pounds thrown off. After weighing, the spikers with a sharp heavy steel implement remove the heads, and spike out a piece of rosin large enough to cut a sample 7-8 inch by 7-8 inch. This must be cut from rosin at least six inches below the surface of the barrel, so the spiker has to go at least to that depth. Of each lot ten per cent. must also be inspected at the bottom heads, to ascertain that there are no mixed grades or other irregularities. After the rosin is spiked, a sample-cutter with sampling adz with a few licks cuts a perfect cube of required dimensions, and places it on the top of the barrel. The inspector takes up each piece, holds it up to the northern light to get the true shade, compares it with his type, and calls the grade, which is immediately put on the barrel with a brush by the marker. The inspector's clerk makes original and duplicate certificates, as for the spirits, which are checked and signed by the inspector, and certificates, with duplicates, sent to the offices of the factor, to whom the rosin was consigned by the producer. The cooperage crew replace the heads securely and see that packages are in merchantable condition.

The standard rosin types that the inspectors use in deciding the grades of the rosins sampled by them are provided by the Savannah Board of Trade, which secures them from Mr. Harris M. King, Georgia State Supervising Inspector. These inspector's samples are renewed every two months, or more frequently if necessary, as with constant use they are likely to bleach out.

Whenever an inspector meets with an instance of adulteration of turpentine or false packing of rosins, the cask or barrel that is a violation of the trade regulations and State laws is set aside, and the attention of the State Supervising Inspector is called to it, he proceeding as the law sets forth.

The inspectors are sworn city officials, elected by the Mayor and Aldermen of the City of Savannah, and they do their work under State laws and city ordinances. They are required to give bond for the faithful and honest performance of their duties, and are liable to prosecution and severe punishment for any illegal practices. It is a matter of gratification to the corps of inspectors that in a quarter of a century there have been charges preferred against an inspector but one time, and in that instance on a trial by the City Council the inspector was honorably acquitted.

There are four inspectors at Savannah, all of whom were elected on the endorsement of the trade. No incompetent man could hope to secure an election, or to retain the position. The inspectors are paid fees, fixed by law, nine cents for each barrel of rosin, and twelve cents for each cask of spirits turpentine inspected. The naval stores factor pays the fees, and they are charged up to the producer whose stuff has been inspected. The inspectors pay all of their help out of the fees received by them. The maximum number of barrels inspected by an individual inspector in the course of a day's arduous work is three thousand. This is very exceptional. An average day's work for an inspector during the height of the season is twelve hundred barrels of rosin and three hundred casks of spirits turpentine.

When turpentine is placed in the tanks its purity becomes guaranteed by the tank company. When it is taken out of the tanks, it is re-gauged, but not again inspected as to its quality. The inspector receives a fee of six cents per cask for this re-gauging.

The inspectors at Brunswick, Ga., and at the Flordia ports, all pursue the same methods as those outlined for the Savannah inspectors. Practically all of the inspectors have been engaged in the business for many years, and disputes as to the correctness of their work are few and far between.

WHY SAVANNAH MAINTAINS ITS PRESTIGE AS A NAVAL STORES MARKET

(By J. C. Nash.)

[Mr. J. C. Nash was for some years connected in important capacities with the foreign and domestic departments of The Paterson-Downing Co. and The American Naval Stores Co. On the organization of The Columbia Naval Stores Co. in 1918 Mr. Nash became vice-president and during the long illness of its president, the late H. A. Schroder, was general manager of its business. In February, 1920, Mr. Nash was elected president of the company. Mr. Nash has made several business visits to Europe and is well known to the naval stores trade in its various countries.]

THE offhand and unthought-out reply of the average person to the question: "Why does the sun rise in the morning?" might easily be "Because it has always done so," and likewise when the question represented by the above title is propounded the same kind of an answer even by one whose experience dates back into the last century might be, because it has always done so. It is accepted as a basic fact. The reasons therefor are sound and as they are fundamental they are more often accepted than inquired into.

Primarily the answer is in the geographical situation of the city as related to the territory representing a great percentage of the production, from which section there are many and diversified rail freighting opportunities combined with which is the steamer outlet from the port not only to domestic destinations but to all the important ports of the world by a varied foreign shipping service. The coastwise outlet by old established steamship lines to Boston, New York, Philadelphia and Baltimore means a steady and frequent shipping opportunity to the centers of consumption and to practically every foreign country whose industries are sufficiently great to require rosin and turpentine as well as to other countries still in a formative period the foreign outlet is large. The railroad lines coming into Savannah are trunk lines of national importance, besides other lines of a more local nature.

To care for this commerce adequate banking facilities are needed and Savannah is blessed with numerous banks characterized by both conservatism and progressiveness, and it is significant that there has never been a bank failure in Savannah's history.

Such accommodation and such physical advantages need not necessarily sustain a premier position unless combined with the fact that the naval stores merchants at Savannah have through so many years had the experience which in turn has brought about the responsibility of maintaining on a high plane of fairness the conditions surrounding the basic market. This is an extremely important matter, for the operations at Savannah and the quotations based on these operations have a world-wide influence in the naval stores industry. Practically every contract for naval stores that is made in this country is either directly or indirectly based upon the quotations of the Savannah Board of Trade and it is, therefore, essential and it is a fact that these quotations, speaking broadly, are as fair and equitable as it is possible to have them, and it should be repeated that this is due to the long experience of the Savannah merchants in insisting upon the quotations being equitably established. It is perhaps not ordinarily realized what a serious difference it would make throughout the entre industry unless the proper protection were placed around the market by careful supervision of the Savannah Board of Trade, but unless this were true it would lead to great confusion throughout the buying and selling ends of the business, which confusion is under present conditions almost entirely avoided.

Furthermore, it should not be overlooked that throughout the section of the naval stores belt which counts Savannah as its port of outlet there is a varied and well defined assortment of the different grades of rosin, which fortunately makes a natural market for all and makes it possible that fair quotations are daily reported.

Practically every large export house in this country has its own office in Savannah and this is also true of certain foreign interests whose presence is welcome at this open port. Such companies feel the vital necessity of being resident or having adequate representation at a point from which the conditions of production can be so well observed and from which it is necessary that the bulk of shipments be arranged, and the importance of keeping in constant contact with shipping opportunities which are so numerous from Savannah is fully realized.

The above facts are so well established that not only is it an entirely logical result that Savannah is the basic and premier port but it is also of great advantage to the industry as a whole that this is the case.

THE NAVAL STORES FACTOR

(By H. Weibert.)

[Mr. H. Weibert was for many years manager of the Antwerp Naval Stores Co. at Savannah. He became president of the Peninsular Naval Stores Co., of Jacksonville, on its organization, and for some years has been a prominent figure in the naval stores trade of the Florida metropolis.]

THE naval stores factor is a commission merchant, wholesale grocer and dealer in supplies such as are used by naval stores producers. His business is to assist operators to engage in the production of naval stores by advancing him part of the money needed to buy or lease timber, to assist him in buying such things as are required on a turpentine place, and to furnish the means for carrying the place during the winter when nothing is produced, but money is required for the preparation of the place for the coming season. He sells the rosin and turpentine consigned to him by his customer, on the open market to the highest bidder on a commission, and sells to his customers groceries and supplies.

It is not in the province of the factor to do a dealing business because this would necessitate his taking a stand on the market, which would mean that he would have to be either bear or bull. The operator expects prompt sales returns for the stuff shipped in, and in order to accomplish this, the rosin receipts which contain many grades, are sold in lines in the primary markets.

There are few operators in the East who do not employ factorage houses. The reasons are obvious. The factor, who works with a large capital, is always ready to assist a responsible producer to acquire turpentine timber, and never calls for the money he has advanced unless an account has become unsatisfactory. Such liberal treatment a turpentine operator could not obtain from the banks, and unless his own resources are adequate he will have to get his accommodations from the factor or he cannot engage in the naval stores producing business. The factor uses his best endeavor to sell the rosin and turpentine consigned to him to the operator's best advantage. He does not engage in speculation unless requested by his customer to withhold his stuff from the market, but always endeavors to obtain the best possible prices.

The factor defends the rights of the operator and sees to it that the latter is fairly treated in all questions which come up between the buyer and seller, and which are agreed upon in the established Chambers of Commerce. He wants his customer to feel that he can call upon him with anything touching upon his business and be assured in advance of a considerate hearing of his case and that his interests will be taken care of. The factor keeps in personal touch with his clients, understands their wants and serves them to the utmost of his ability, for his success is based upon their prosperity.

THE INCREASED COST OF NAVAL STORES PRODUCTION

(By J. A. G. Carson.)

[Mr. J. A. G. Carson has been actively and prominently connected with the naval stores industry and trade for the past thirty-six years. After some years business experience in other lines he became, in 1884, a partner and vice-president of the naval stores factorage house of J. P. Williams & Co. of Savannah, one of the largest handlers of rosins and spirits turpentine. In 1897 the firm name was changed to the J. P. Williams Company, and in 1910 to the Carson Naval Stores Company, with Mr. Carson as the president. During all of his long connection with the industry he has been a student of conditions affecting production and consumption and at serious times in the history of the industry has been a potent factor in tiding it over crises. When the Rosin & Turpentine Export Co. was organized he became a director and under its reorganization in 1916 served as president until an exporter could be secured as executive. He served as president of the Savannah Board of Trade 1908-12. During that time and since he frequently acted as spokesman for the trade in matters of importance at Washington, and has been largely instrumental in bringing about friendly government co-operation and assistance and creating a keener appreciation of the importance of the naval stores industry to the general welfare of the country.]

PROBABLY the most difficult figures to obtain in the naval stores industry are the cost of production, for they vary as the points of the compass.

In the summer of 1918, the War Industries Board were anxious to ascertain what it cost to produce the co-products -spirits of turpentine and rosin, their object being to fix maximum values should profiteering be proven. The committee representing the manufacturers of naval stores declined to throw any light upon the subject, affirming that the cost was constantly varying, depending upon locality, the running quality of the timber and ability of the individual manufacturer, and that any assumed cost of production, while fair to some producers, would be unjust to others.

The War Industries Board then requested the U. S. Department of Agriculture to investigate and report upon the cost of production. The Bureau of Chemistry of the Department of Agriculture put a force of men in the field and after several months of investigation and effort were unable to make a report satisfactory to themselves as to the cost of production, the figures of their field men varying in some instances as much as 300 per cent.

The cessation of hostilities on November 11, 1918, brought the efforts of the War Industries Board to a close and producers were saved the embarrassment and loss that would have occurred had maximum selling prices been fixed upon their products.

Each succeeding decade brings an enormous increase in the cost of producing naval stores and no relief is apparent. Thirty to forty years ago lands with the finest running long leaf pine timber in abundance thereon, could be purchased in fee simple at from $1.50 to $2.50 per acre; these lands are now cleared and selling at anywhere from $25.00 to $40.00 per acre. Turpentine privileges could be leased for three years at from $50.00 to $100.00 per crop of 10,500 boxes; the same privileges now cost the producer from $1,000 to $2,500 per crop, and for a vastly inferior grade of timber.

In those days labor was abundant, cheap, healthy and efficient. Every fall and winter trainload after trainload of expert turpentine negroes were brought into Georgia, Florida and Alabama from North Carolina and South Carolina (the turpentine industry declining in the latter states and undergoing development in the former). Labor was so abundant that Sambo was willing to work efficiently for six days in the week and give good value for the wages paid him. Times have changed and Sambo with them. The competition between the employers of labor became so keen that Sambo's compensation was increased. Did it help? No. At first Sambo found he could get along by working only five days in the week; afterwards he found he could live by working four days in the week, and later on (wages still advancing) three days in the week. It is safe to say that the average turpentine laborer at present does not work over three days in the week and loafs and fishes or hunts the remaining four days. Again, Sambo is not as strong, vigorous or healthy as he was thirty to forty years ago. Disease has made inroads into his constitution and he cannot give the service now as then even should he so desire. Today the producer pays exceedingly high wages for very poor work, the result being that it takes from two to two and one-half men to do one man's work and the expense of operating the average turpentine farm is ten times more than in the period mentioned.

The turpentine industry is essentially a large consumer of food for both man and beast. While many producers operate in connection with their turpentine farms a farm for the purpose of raising some of the food consumed on said turpentine farms, thereby helping to pay and reduce expenses, yet a large majority of them purchase everything they need in the way of food. Values of flour, meat, meal, hay, corn and oats have enormously increased during the last three or four decades, thereby adding to the cost of production.

Invested capital has necessarily been multiplied many times. In the decades mentioned a producer could secure a location good for from eight to ten years on a primary investment of ten to twenty-five thousand dollars; an investment of from seventy-five to two hundred thousand dollars would be necessary today to secure the same location, if one were obtainable.

Figures are before the writer showing the actual results obtained in 1919 in working quite a number of turpentine farms, both in the South Atlantic and Gulf of Mexico territories. There is a difference in favor of the South Atlantic places, the large places in the Gulf territory not showing the net profits per unit of production as shown in the former territory.

When the fact is taken into consideration that the industry suffered from four or five lean years, the operating profits cannot be termed excessive, especially when the short life of a particular place is considered.

The year 1920 will not yield to the producer as large net returns as the previous year, as the cost of production has increased and is constantly increasing.

THE WORLD'S PRODUCTION AND CONSUMPTION OF SPIRITS TURPENTINE AND ROSIN

(By Thomas Gamble)

PRIOR to the recent war the world had reached the point where it could annually readily consume over 850,000 barrels of spirits turpentine (42,500,000 gallons) and 2,750,000 barrels of rosin of 500 lbs. each.

For a term of years the United States had approximately supplied 650,000 barrels spirits turpentine and 2,150,000 barrels rosin. while France had supplied 130,000 barrels spirits turpentine, Spain and Portugal 50,000, Greece 15,000, India 2,500, and from other sources of supply, not including wood distillation plants, there came perhaps 15,000 barrels, with rosins in proportion.

It is a conservative estimate that including the wood turpentine plants and every possible source of supply of gum turpentine the world took care of close to 900,000 barrels spirits turpentine in its best consuming years, or the enormous total of 45,000,000 gallons, while of rosins it could absorb in a twelve months of undisturbed industry close to 3,000,000 barrels of 500 lbs. each.

Few probably realize the extent of the production and consumption of these two important commodities. The industrial uses for rosin were continually increasing and but for the war and its devastations every barrel the United States and other producing lands could turn out would by this time be readily marketed. The contraction of the industry in the United States is apparent to all. There is reason to believe that sagacious France, with its progressive methods, will widen the areas of its turpentine forests and gradually increase what it has found to be a profitable and permanent crop. Its output in coming years can no doubt be considerably increased, but not sufficiently to offset what promises to be the decrease in production in this country. Spain, Portugal and Greece must remain minor factors, with possibilities of but small increases in crops. Algiers, Tunis, Corsica, etc., are inconsequential. Mexico and Central America may become important producers, but nevertheless in a small way compared to the United States and France. Russia in the decade after 1930 may be a source of great supply, with its illimitable forests. India, as shown elsewhere, can not hope to produce a maximum beyond 37,000 barrels spirits turpentin and 100,000 barrels rosin in a year. Japanese plans for forestation look to the distant, not the near, future.

The Douglas firs of the American Pacific coast give promise of exploitation for naval stores on a large scale if the claims as to the results obtained from their working are shown to be well based. Several Southern naval stores concerns are already investigating that specie of resinous tree and if the reports bear out the assertions of the promoters of the industry a considerable development will doubtless ensue in a few years.

The progress of the wood turpentine industry is such as to justify the expectation that with each year, for some years to come, there will be an increase in its output and a ready market for the spirits turpentine and rosin and other commodities supplied by it. The areas of cut-over pine lands are enormous and the possibilities of this industry have even yet been scarcely appreciated. With the world settling down to normal industrial development in a few years it is clearly within the range of probabilities that fifteen to twenty years hence—and time passes quickly—its old consumptive demand for rosins and turpentine will be restored, if not augmented. Indeed, given the development of its consuming industries that may readily be looked for, one can conceive a period within the life of the present middle-aged dealer when the world can absorb in a twelve months 1,000,000 barrels of spirits turpentine and over 3,000,000 barrels of rosin, or fifty million gallons of spirits turpentine and one billion, five hundred million pounds of rosin.

The quest for new sources of supply is now on. It will be accelerated and accentuated and made world-wide within a period of the next ten years. The world must and will have spirits turpentine and rosin.

THE PRODUCTION OF NAVAL STORES IN THE UNITED STATES

HOW THE INDUSTRY HAS MOVED FROM CAROLINA TO TEXAS, WITH TABLES OF CROPS AND PRICES OF TURPENTINE AND ROSINS

(By Thomas Gamble.)

UNTIL the middle of the last century the Carolinas were almost the sole source of supplies of American rosins and turpentine. From their forests came sufficient of such commodities to meet the needs of the consuming industries of the United States and a considerable excess for export, mainly to Europe. The production had been a matter of slow development. The industrial growth of the country in the first fifty years of the twentieth century, important as it had been, was, after all, in a minor way as compared with the giant strides its manufactures took after the war closed in 1865. The requirements for rosins and turpentine for domestic consumption were limited and the foreign shipments in 1850 totaled but 13,000 barrels of spirits turpentine and 298,000 barrels of rosin. The crops drawn from the pines of the Carolinas were accordingly entirely adequate for all demands and in consideration of the sources of supply those two States ranked as 93 per cent. The census of 1850 found little to report outside of their bounds, as shown in the following statement:

State.	No. Plants.	Value Output.	Pct. of Output.
North Carolina	785	$2,476,252	87.310
South Carolina	40	235,833	8.315
Georgia	14	55,068	1.942
Florida	7	29,671	1.046
Alabama	4	17,800	.628
Mississippi	5	19,680	.697
Louisiana	1	1,750	.062
	856	$2,836,057	100.

Many of the North Carolina plants were small affairs and their production was not comparable to the output of an equal number of plants in Georgia or other States in later years.

The decade that followed (1850-60) saw the first spreading out of the naval stores industry as now understood, and while the resulting production elsewhere was petty the fact that the operators had further edged their way into other States had its significance. Georgia, Alabama, Florida, Mississippi, Louisiana, each had its prosperous turpentine farms when those States seceded in 1861. True, their total production of spirits turpentine and rosins was so small as to hardly justify especial consideration, but their operations had the effect of keeping before the producers of the Carolinas the fact that apparently inexhaustible forests lay to the South and Southeast and probably encouraged them in the continuance of the wasteful methods of the industry. Two decades were to pass before they availed themselves of them to any extent and began the migrations that eventually lead them to the six other longleaf pine States. In 1860 the Carolinas still furnished over 90 per cent. of the total output of the two commodities. In a chart denoting production the line for those two States in comparison with former years would merely indicate the beginning of the shrinkage of relative position, while the other States would be but minute dashes to tell of initial operations. (See footnote.)

The foreign trade in the intervening ten years had grown greatly, the exports in 1860 being 81,000 barrels spirits turpentine and 432,000 barrels rosin. The five years of war that followed brought the industry to almost a complete cessation. The needs of the Confederacy for rosins and turpentine were easily supplied, the probability of running the blockade with cargoes of them for Europe was soon remote, the white men were in the army or at work in the fields producing more important crops. When the industry was revived after Appomattox it was in a small way. Some stocks were available for shipment but the total movement out of the country in 1866 was but 7,000 barrels spirits turpentine and 140,000 barrels rosin, and by 1870 they were but 65,000 barrels spirits turpentine and 327,000 barrels rosin, or less than the exports of 1860 figures, though, which show the reconstruction of the industry in the Carolinas despite the handicapping difficulties under which it labored. In 1860 a total of 625 establishments had been reported in the nation's industrial enumeration, and in 1870 reports were secured from but 225, the census of that year being esteemed of little or no value. It was estimated at the time that the production was about 125,000 barrels spirits turpentine and 450,000 barrels rosin. The world continued to look to the Carolinas for its supplies and there was but a negligible proportion of the crop made south of the Savannah river. The dealers of this and other countries traded with Wilmington and Charleston.

The next ten years (1870-80) found the production of the Carolinas growing greater in bulk than ever before, but likewise brought into public recognition the probabilities of the industry speedily enjoying a considerable expansion elsewhere. The world's requirements were forcing the industry ahead in the Carolinas at a rate that presaged the rapid diminution of the supplies by exhaustion of the pine forests. By 1880 the foreign shipments had jumped to 142,000 barrels spirits turpentine and 583,000 barrels rosin. Demoralizing though the "War Between the States" and its subsequent effects on negro labor had been, the naval stores industry, as a producer of raw supplies in constant and increasing demand and requiring a minimum of skilled workmen and of invested capital, had been speedily re-established and in a comparatively few years had reached proportions beyond anything in its former history. By 1873 production had passed any previous figures. The census of 1880 brought this expansion of the industry very forcibly to light and furthermore centered the attention of students of the

It was natural that destructive methods should have characterized this industry, for the early settlers in Eastern North Carolina found forests of longleaf everywhere. Clearance was necessary for agriculture, crops had to be grown, lumber was needed for industry, homes had to be built, and so the work of destruction began. It was immediately recognized that this tree, when wounded, is a prolific producer of an oleoresin, "crude turpentine." Furthermore, the rich resinous wood, when heated out of contact with air by piling in heaps and covering with earth, gave off a rich distillate of tar, which could be boiled down to a pitch. These products, tar and pitch, were much needed for the wooden ships with their extensive rigging, at that time universally in use; and so along with agriculture, with its yearly crops, there developed the naval stores industry, with its constant output of immediately marketable products. The method of conducting the industry called for no plant other than the forests and so when the yield of the trees began to decrease after two years of operation new tracts were opened, and the industry began its march southward from North Carolina into South Carolina, thence into Georgia and Florida, and then rapidly expanding into the Gulf States, though on a smaller scale.—Dr. Charles H. Herty, in address on "The Turpentine Industry in the Southern States" Philadelphia, November 4, 1915.

industrial life of the country on the fact that in other Southern States this particular industry was forging ahead. Of the greatly increased production of that year approximately only 60 per cent. came from the forests of the Carolinas. Georgia, in particular, was looming up in the statistics of the industry and its 84 reported establishments had products not far behind the output of the 184 establishments in North Carolina. The census report for 1880 furnishes this significant comparison:

State.	No. Plants.	Value Output.	Pct. of Output.
North Carolina	184	$1,758,488	29.947
South Carolina	192	1,893,206	32.241
Georgia	84	1,455,739	24.791
Florida	10	295,500	5.033
Alabama	26	372,050	6.336
Mississippi	11	97,000	1.652
Totals	507	$5,871,983	100.

It remained for the next decade (1880-90) to give the great impetus to naval stores farming south of the Carolinas. By 1890 the crop had grown to approximately 500,000 barrels spirits turpentine and 1,600,000 barrels (500 lbs.) rosins, and the relative position of the several producing States had undergone a tremendous change. The Carolinas in this period had passed the apex of their production and had become unable to meet the requirements of consumers at home and abroad to the same extent as heretofore. A growing shrinkage in their output was apparent to all. Financial returns from the farms had likewise improved and the incentive to seek new locations was sufficiently strong to allure the operators to other States, more especially to Georgia and Alabama, and to the working of larger acreages than in the past. Turpentine farmers from North Carolina greatly expanded their operations when they reached the virgin forests of Georgia, and the production per establishment became greater. The census taken in 1890 furnished convincing evidence, if any were needed, that the center of production had moved outside of the Carolinas and that they had been reduced to a secondary position. While the government statistics at that time were regarded as merely approximately correct, their accuracy as to the proportions of the several States involved makes the statement a fairly representative picture of the position; then occupied by the naval stores producing States:

State.	No. Plants.	Value Output.	Per Cent.
North Carolina	194	$1,705,833	21.119
South Carolina	201	1,524,100	18.869
Georgia	228	4,242,255	52.520
Florida	15	191,859	2.375
Alabama	7	114,866	1.422
Mississippi	24	282,066	3.492
Missouri	1	16,400	.203
	670	$8,077,379	100.

From the 100 per cent. production of 1840, the 93 per cent. of 1850, the 90 per cent. of 1860, and the 62 per cent. of 1880, the Carolinas in 1890 had been reduced to furnishing but 40 per cent. of the crop. Georgia now loomed most prominently in the naval stores world. Savannah assumed its place as the port and market of crowning importance. In the meantime the crop had grown to tremendous size as compared with what it had been two decades before. Home consumption had grown tremendously and the export demand had expanded to such an extent that it absorbed quantities vastly greater than the full crop of 1860. In 1890 the total foreign shipments were 225,000 barrels spirits turpentine and 897,000 barrels rosin, three times as much of the former and twice as much of the latter as in 1860. By 1900 the foreign demand required the shipment of 332 000 barrels spirits turpentine and 1,327,000 barrels (500 lbs.) rosin. The maws of the consuming industries throughout the world now devoured such increasing quantities as to demand greater and greater production. Year after year they had increased in numbers and variety, country after country had taken its position as a buyer, the world as a whole had become dependent on the Southern States for the greater part of its naval stores, and rosins and turpentine bulked largely in the foreign commerce of the United States. From 1900 on the industry assumed a position of importance in the nation's trade relations far beyond anything it had held prior to that time. Its products as never before were the essentials of industries in every nation enjoying a highly developed modern life. (See footnote.) A fleet of ships bore them to the uttermost parts of the earth. Their value had passed $20,000,000. The production as given in the census report of that year (1900) placed the States in the following relative positions:

State.	No. Plants.	Pct.Total Production.
North Carolina	174	5.19
South Carolna	132	3.88
Georgia	524	39.86
Florida	366	31.80
Alabama	152	9.99
Mississippi	145	8.71
Louisiana-Texas	10	.57
	1,503	100.

For the season of 1900 the trade estimate of production approximated 700,000 barrels spirits turpentine and 2,300,000 barrels rosin (500 lbs.). The greatest volume of foreign shipments was in 1901, when 1,985,000 barrels of naval stores were moved abroad, including 405,000 barrels spirits turpentine and 1,580,000 barrels rosin.

The Carolinas at the opening of the present century had fallen in production to 9 per cent. of the total, the proportion of the crop furnished by the two States having declined as follows:

Year.	Percent. Supplies From Carolinas.
1840	100.
1850	96.
1860	90.
1880	62.
1890	40.
1900	9.
1905	5.7
1909	4.3
1919	0.5

The early census reports of the government on the industry have never been accepted as reliable. They have been looked upon as merely guides to the development of the industry in the several States and not even as approximately accurate statements of the production. In fact, some of the census reports were repudiated by the trade at the time, such as that issued in 1900, which showed a production for 1899 of 750,000 barrels of spirits turpentine and rosins in proportion, manifestly greatly in excess of the actual crop. In recent years, though, the efforts put forth to secure reliability in reports, and a better understanding of the importance of accuracy on the part of the producers in making reports, have had their effect and the statistical statements from year to year have attracted more attention and been regarded with more favor. The figures are now collected every five years by the Census Bureau, but not tabulated and given out until nearly a year has passed. In the interim, special reports are compiled and issued by the Bureau of Chemistry, Department of Agriculture, which has done such intelligent and effective work in promoting and protecting the interests of the industry. The following table is regarded as approximating as closely to the production for terms of five crop seasons as current private sources of information made it possible to determine. Census Bureau reports were for calen-

A survey made by the government several years ago demonstrated that the consumption of rosins in the United States was distributed approximately as follows: Soap factories, 41 per cent.; paint and varnish factories, 24 per cent.; paper mills, 15 per cent.; rosin oil factories, 9 per cent.; miscellaneous industries, 11 per cent. Of the consumption of spirits turpentine 70 per cent. was in the production of paints and varnishes.

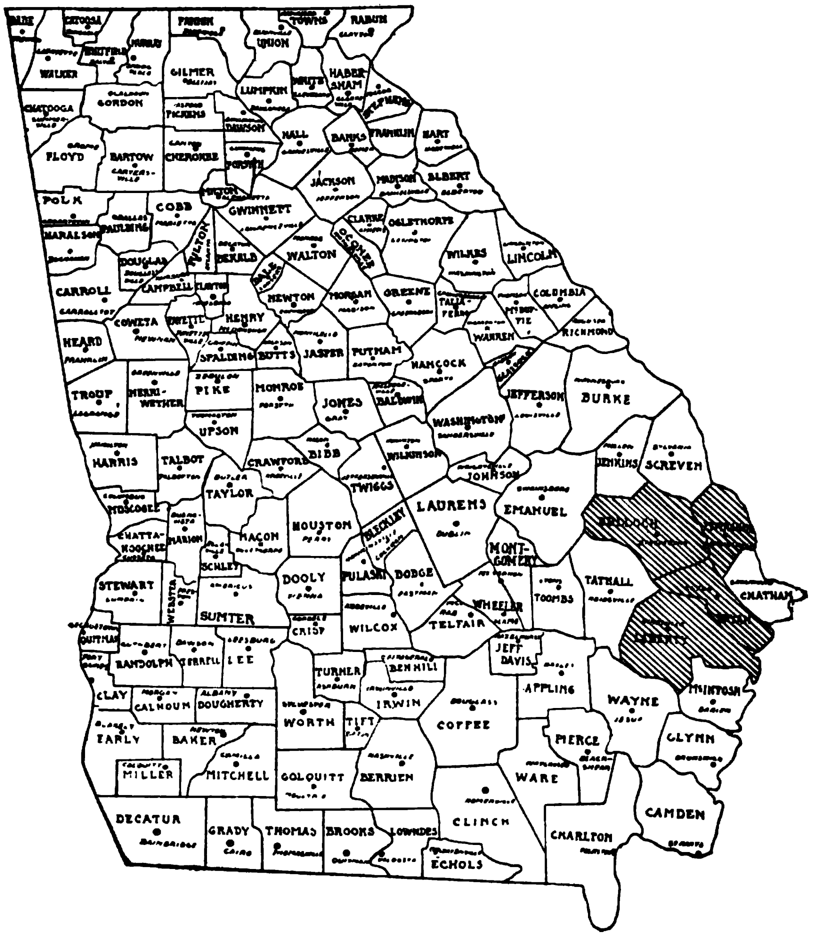
Dark Portions Show National Distribution of the Long Leaf Pine. Map Prepared by the U. S. Forest Service.

dar years, but the following for the crop years closing March 31:

Approximate Avg. Annual Production for Five Crop Seasons	Spts. Turp. Bbls. 50 Gals.	Rosins, Bbls. 500 Lbs.
1890-95	515,000	1,720,000
1895-1900	585,000	1,950,000
1900-05	655,000	2,185,000
1905-10	655,000	2,185,000
1910-15	650,000	2,165,000
1915-20	480,000	1,600,000

The year of greatest production was the crop season of 1908-09, credited by the trade with 750,000 barrels (50 gallons) spirits turpentine and 2 500,000 barrels (500 lbs.) rosins. The effect of over production for several seasons brought the industry to the verge of ruin, and there was a sharp cut in the crops after this maximum was reached, the next crop season bringing a production of hardly 600,000 barrels spirits turpentine and 2,000,000 barrels rosin. Production had become fairly approximated to consumption when the World War broke out in 1914, with its cessation of trade for many weeks, and immediate steps were taken to curtail production, despite the fact that the season was half way through. With the readjustment of international trade and the new demands that the war's activities brought for rosins, the production again increased temporarily, but the expectations of after-war trade were disappointed and in the season of 1918-19 successful efforts were again put forth to curtail the crop and force values to a sufficiently high level to protect the industry from the bankruptcy that threatened it, many having succumbed to the stress of unprofitable operations and closed down. For that season the production was reduced to 340,000 barrels spirits turpentine and 1,115,000 barrels rosin, putting the prices on the highest level ever known. The crop that year was the smallest in thirty-five seasons. A difference of opinion prevails as to the succeeding crop (1919-20), the Bureau of Chemistry report placing it at approximately 366,000 barrels spirits turpentine and 1.233,000 rosins, while trade estimates range from 390,000 to 410,000 barrels turpentine and 1,275,000 to 1,350,000 rosins. The census report of production for 1919 (calendar year) had not been made public up to September 30.

During the past fifteen years the southwestern territory has been increasingly important as a naval stores producing section. From 11 per cent. of the crop in 1905 the three States of Mississippi, Louisiana and Texas have moved in relative importance until in 1918-19 they furnished over 31 per cent. For the current year they may not retain this relative position, the increase in the crop in the eastern territory being greater than elsewhere, but in coming years, considering the available timber and prospective reforestation and conservation measures for the prolongation of the industry, Louisiana and Texas, more particularly, may furnish a much greater per cent. of the reduced supplies than heretofore, although the areas in them originally occupied by the long leaf pine were comparatively small, as shown in the accompanying map, giving the distribution of the primeval growth of that tree. The peculiarity of the isolated Louisiana and Texas pine forests, abruptly cut off from the main bodies of such trees to the east, is explained by the Forest Service as follows: "The distribution of the longleaf pine is primarily controlled by the occurrence of a clay-marl soil to which it is peculiarly adapted. Wherever this soil is found, the specie occurs practically pure. As the soil is combined with or overlaid by others, different species begin to come into the stand. The clay-marl soil occurs in Texas and Louisiana apparently cut off from the main body of the formation by the intervening lowlands. As a re-



In an area about equivalent to the four little counties in Southeast Georgia shown shaded on the above map of that State, embracing 2,850 square miles, the turpentine operators of France are this year producing approximately 150,000 American barrels of spirits turpentine (50 gallons each) and 450,000 barrels of rosins (500 lbs. each). Conducted as the industry is in France, in fifteen to twenty counties of Georgia, if devoted solely to the industry, as much naval stores could be produced as are this year being made in all of the Southern States. Naturally one asks: Is there any reason why the naval stores industry should not continue a large, permanent and very profitable industry in the South?

sult, longleaf pine is found in these two States approximately following the formation."

Given a favorable opportunity, it has been conclusively demonstrated that the longleaf pine will reforest itself. Its self perpetuation is merely a matter of reasonable care, and largely, as indicated in other articles in this volume, of preservation from the ruin wrought by fires and the destruction of the baby trees by predatory hogs. In Georgia this year considerable areas of timber lands are being worked for turpentine from which crops of naval stores were made twenty to thirty years ago. The naval stores operators moved away, the lumbermen cut off the profitable timber, and the land was allowed to look after itself. The immature saplings have grown to strong, healthy, resin-bearing trees and are now in process of boxing or cupping, while about them is another growth of saplings that, given protection and time, will make another crop possible fifteen to twenty-five years hence. There is no reason for the disappearance of the industry on a considerable scale in Georgia, or any other section in which the longleaf pine is native, except the wilful disinclination of man to give a helping hand to nature in its efforts to replace what has been removed. (See footnote.)

The accompanying table is an approximation of the proportion of total supplies furnished by the several naval stores States in recent years. Roughly speaking, the southwestern territory is now furnishing about one-third of the supplies, Florida a third, and Georgia and Alabama together a third. The original sources of supply, North and South Carolina, furnish hardly one-half of one per cent. of the turpentine and rosins made in the South today. With the awakening that has been brought about by the publication of the government's estimate of the brief future life of the industry if carried on as it has been, it is reasonable to suppose that none of the other States will fall into the same category as the Carolinas, but that each will continue a source of considerable supplies, although never again together approaching the era when 700,000 barrels of turpentine could be readily produced in a twelve months. There is no reason why the Southern States after the next few years should not indefinitely supply the world with an average of 300,000 barrels of turpentine and a million barrels of rosins, and find in the higher values an offset for the reduction in production. As France for a half century has made its artificial pine forests profitable, so the Southern States can make of their forests a perpetual source of large revenues and continue to give suitable employment to many thousands of their people.

The accompanying table gives the government estimates of production in recent years, as compared with trade estimates for the same years. As a general proposition, in recent years, government figures are below trade estimates, whereas in earlier years the reverse tendency was noticable. The fluctuations of production are apparent from this and other tables and can be studied with relation to values by comparison with price statements given herewith. Herewith is also given the receipts at the three main ports of Savannah, Jacksonville and Pensacola by months for a number of years. Elsewhere will be found a statement of ex-

Where fire is kept out, reproduction of the pine forest is a comparatively simple process. Investigation has shown many restricted areas that are well stocked with pine today because the areas have not been burned over. In some of the western counties (Mississippi) longleaf pine has borne seed abundantly during the past year. During the warm days of November and December the seed from these trees has germinated throughout the stump-land region. Counts of seedlings made where seed trees were present showed from 12,000 to 15,000 seedlings per acre. One small area was found in one county where fire did not run last year. It was an excellent example of what reproduction would be if fire protection were assured; one-year-old seedlings covered the ground so closely that there was at least one to every square foot. These facts show that it is perfectly feasible to secure natural reproduction wherever even a very few seed trees are left on the ground, but if present abuses persist, nothing but expensive planting operations can make the denuded lands grow up to pine again. It is often contended that longleaf will not succeed itself, and that if pine does come in it will be loblolly. In proof of this, the old fields which usually grow up to loblolly are pointed out. It is true that loblolly does come up on abandoned fields, because the soil that has been tilled offers the ideal germinating bed for loblolly pine seed, which is borne prolifically, and because of its lightness, is carried long distances by the wind; but this does not establish the contention. The reproduction of longleaf is different. This tree bears its seeds in quantity at intervals of from four to eight years, and they are so heavy that they cannot be carried far by the wind. Large quantities are eaten by weevils, squirrels and hogs; yet, where fire and grazing have not been common the reproduction is satisfactory.—From "Condition of Cut-Over Longleaf Pine Lands in Mississippi," by Messrs. Holmes and Foster, U. S. Forest Service, 1908.

ports by years (1800-1920), which furnishes an interesting study by comparison with production. Generally speaking, prior to the World War, more than half of the production went foreign, reports for eight years averaging over 51 per cent. turpentine and 62 per cent. rosins.

As regards future production in the Southern States, it may not be amiss to present in the most forceful manner possible the difference in the area utilized by the industry in this country and in France, and the resulting production.

As all know, the naval stores territory in this country extends over great sections of Georgia, Florida, Alabama, Mississippi, Louisana and Texas. The resulting crop this year promises to be approximately 525,000 barrels spirits turpentine and 1,700,000 barrels rosin.

What more striking commentary could there be on the industry as practiced with us and by the French than the presentation on the accompanying map of Georgia of the relative area occupied by the French forests of the Landes district from which this year the production gives promise of reaching 150,000 barrels of turpentine and 450,000 barrels rosins, (American standards).

The area occupied by the turpentine industry in Landes is given as about 2,900 square miles. In the four moderate sized counties of Georgia shaded on the map there are 2,850 square miles, or practically the same area as occupied by the French naval stores industry. This little bit of Georgia soil is hardly noticeable when compared with the vast extent of country, from the Savannah river to the limit of the Texas longleaf pine belt, that is still being worked for turpentine, or that has been left a temporary waste land of pine stumps and immature saplings.

Fifteen to twenty Georgia counties planted and developed and worked as systematically as the French Landes district has been would furnish thirty to forty years hence as much naval stores as the entire Southern States will supply this year, and instead of an itinerant and disappearing industry there would be a fixed, permanent and highly profitable industry. Is it to be believed that the temperament of the South is such as to render this impossible?

PERCENTAGES OF PRODUCTION SUPPLIED BY THE SEVERAL SOUTHERN STATES

STATE	1905	1907	1908	1909	1910	1914	1917	1918-19
Alabama	10.114	10.380	10.191	9.798	8.469	10.081	12.058	12.220
Florida	41.925	45.614	46.580	47.645	53.694	45 826	35.900	36.912
Georgia	31.158	29.532	28.317	27.790	25.045	23.090	20.547	19.250
Louisiana	00.816	3.289	4.651	4.244	2.882	8.340	14.212	15.517
Mississippi	10.277	6.579	6.156	5.486	6.306	8.840	9.946	9.405
North and South Carolina	5.710	4.386	3.558	4.278	3.063	1.423	00.579	00.460
Texas	***	00.220	00.547	00.759	00.541	2.400	6.758	6.230
Totals	100.	100.	100.	100.	100.	100.	100.	100.

*** Included in Louisiana.

The Bureau of Chemistry, Department of Agriculture, Washington, D. C., furnishes the following figures, compiled by it, as to the production of naval stores for the crop season of 1919-20. In this connection it may be well to state that other estimates of production are considerably in excess of these figures, more especially as to the output in the southwestern section of the turpentine belt. The Bureau, after its first announcement, made a further investigation and adheres to the figures given herewith:

SPIRITS TURPENTINE.

STATE.	CASKS.	PERCENT.
Alabama	38,100	10.4
Florida	136,900	37.4
Georgia	73,900	20.2
Louisiana	68,700	18.8
Mississippi	29,500	8.0
North Carolina	600	......
South Carolina	1,100	0 5
Texas	17,200	4.7
Totals	366,000	100.0

ROSINS.

STATE.	BARRELS.	PERCENT.
Alabama	126,000	10.2
Florida	457,500	37.0
Georgia	250.600	20 3
Louisiana	232,000	18.7
Mississippi	102,800	8.3
North Carolina	2,200	......
South Carolina	3,400	0.5
Texas	62,500	5.0
Totals	1,237,000	100.0

RECEIPTS OF SPIRITS TURPENTINE IN BARRELS OF 50 GALS. AT SAVANNAH, JACKSONVILLE AND PENSACOLA.

Months.	1914-15	1915-16	1916-17	1917-18	1918-19	1919-20
April	24,732	11,347	15,053	14,127	6,315	6,690
May	47,297	30,394	38,715	33,590	14,699	13,407
June	54,417	39,147	46,797	42,237	19,615	22,656
July	53,510	40,308	33,047	40,168	23,146	23,593
August	27,267	33,286	38,390	33,600	20,193	21,013
September	23,855	27,419	32,919	25,352	14,692	21,574
October	26,230	22,117	26,343	22,385	12,933	19,357
November	23,866	28,901	28,532	22,304	13,167	18,757
December	20,105	21,006	25,276	18,680	11,435	17,109
January	7,492	10,127	12,474	11,223	7,780	8,300
February	5,086	5,219	5,778	6,730	5,545	3,762
March	4,069	4.407	5,356	6,007	3.273	1.876
*Totals	317,923	273,678	315,744	276,413	152,828	184,876

*Revised totals for twelve months, additions or deductions sometimes being made to agree wth revised counts.

RECEIPTS OF ROSIN IN BARRELS OF 500 LBS. AT SAVANNAH, JACKSONVILLE AND PENSACOLA.

Months.	1914-15	1915-16	1916-17	1917-18	1918-19	1919-20
April	72,484	41,798	43,559	40,856	22,593	18,993
May	121,095	82,153	93,943	88,921	45,486	50,879
June	149,373	98,224	116,321	111,358	62,916	62,955
July	152,460	110,501	124,824	114,430	73,202	76,561
August	76,380	101,837	136,015	110,818	69,608	73,402
September	65,908	82,937	110,477	85,635	53,136	72,616
October	82,092	77,055	101,485	81,589	48,894	67,080
November	89,313	118,405	118,457	86,282	55,349	77,125
December	90,138	135,616	118,167	89,154	53,191	76,792
January	45,513	101,538	70,983	71,475	35,606	47,874
February	35,286	77,560	43,564	49,026	22,700	29,303
March	26,926	41,483	33,851	32,874	14,395	14,660
*Total	1,006,968	1,067,116	1,115,879	932,418	557,076	671,241

* Revised totals for twelve months additions or deductions sometimes being made to agree with revised counts.

GOVERNMENT APPROXIMATIONS OF PRODUCTION OF SPIRITS TURPENTINE AND ROSINS BY STATES WITH TRADE ESTIMATES AT TIME FOR SAME YEARS

Spirits Turpentine in Barrels of Fifty (50) Gallons

State.	1905	1907	1908	1909	1910	1914	1917	1918-19
Alabama	62,000	71,000	74,500	56,800	47,000	54,400	57,100	41,600
Florida	257,000	312,000	340,500	276,200	298,000	247,300	170,000	125,600
Georgia	191,000	202,000	207,000	161,100	139,000	124,600	97,300	65,500
Louisiana	5,000	22,500	34,000	24,600	16,000	45,000	67,300	52,800
Mississippi	63,000	45,000	45,000	31,800	35,000	47,700	47,100	32,030
North Carolina	20,000	18,300	14,600	15,600	11,000	3,650	990	875
South Carolina	15,000	11,700	11,400	9,200	6,000	4,025	1,750	690
Texas	*	1,500	4,000	4,400	3,000	12,950	32,000	21,200
Totals	613,000	684,000	731,000	579,700	555,000	539,625	473,540	340,265
Trade Est. at time	590,000	685,000	750,000	600,000	615,000	560,000	520,000	340,000

Rosins in Barrels of Five Hundred (500) Pounds

State.	1905	1907	1908	1909	1910	1914	1917	1918-19
Alabama	202,000	235,000	250,000	173,500	173,000	165,000	186,400	136,200
Florida	810,000	993,000	1,082,000	871,200	1,018,000	733,800	542,300	414,100
Georgia	619,000	657,000	674,000	506,300	487,000	348,000	314,400	215,600
Louisiana	17,000	70,000	109,000	78,100	38,000	150,800	223,400	165,300
Mississippi	203,000	143,000	156,000	107,800	119,000	154,100	149,300	109,100
North Carolina	65,000	95,000	74,000	46,500	40,000	13,200	3,350	3,000
South Carolina	49,000	42,000	40,000	28,800	23,000	9,100	5,600	2,350
Texas	*	5,000	16,000	15,600	8,000	41,600	106,800	68,600
Totals	1,965,000	2,240,000	2,401,000	1,827,800	1,906,000	1,615,600	1,531,550	1,114,250
Trade Est. at time	1,964,000	2,280,000	2,500,000	2,000,000	2,055,000	1,900,000	1,700,000	1,150,000

* Included in Louisiana.

HIGH AND LOW PRICES OF SPIRITS TURPENTINE AT SAVANNAH, GA., FOR EACH MONTH FOR THIRTY-SEVEN YEARS.

YEAR	April		May		June		July		August		Sept.	
	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low
1919-20	72½	70	87¼	72½	1.08¼	90	1.35¼	89	1.71¼	1.37¾	1.69	1.50
1918-19	38½	35½	47	39½	65	45¼	64	54	61¼	53¾	61½	57
1917-18	48¼	45	47	41	41	38	38¼	36	38¾	37¼	45	38½
1916-17	49½	35½	39½	36	40½	37¾	46½	38	43¾	42	45¼	42¾
1915-16	45¾	44½	45¾	38	42½	38½	40¼	38¾	39½	36¾	38¾	35¼
1914-15	44	42¼	46¾	43¾	47½	43¾	46¾	45½	*	*	*	*
1913-14	39½	36	38¾	36	36¼	35¼	36¾	35	40	34¾	39½	38
1912-13	49½	44½	50	44½	46¼	44	44¾	42½	43½	38½	39¾	37¾
1911-12	1.02	72	70	52½	54¼	50½	51¾	49	53¼	48¼	52	50
1910-11	60½	58½	61¾	57¾	59½	55¼	70½	59¾	71	67	76	70
1909-10	39¾	35½	39½	35½	45	37¾	48½	42½	56½	48¼	59½	55
1908-09	50½	42½	44¼	40¼	41½	38½	40	37	37¾	35¼	36¼	35¼
1907-08	69	63	64½	59	58¾	56¾	57½	55¼	57	54	54	50
1906-07	67	64	64¼	57	57¾	57¼	57¼	56¾	61½	57	62¼	60¼
1905-06	60	53	74	56¼	79	55¾	59½	56	61	57¼	66¼	61
1904-05	54¾	52½	55	52¾	54	52½	54	52¾	54¼	52¾	53	51¾
1903-04	51	45	51	45	47¼	45¼	50¼	47¼	55¼	49	57	52¾
1902-03	45	42	45¾	42½	48½	45½	45½	43½	45	43¾	47¾	44¾
1901-02	34	31	33	31	35	31¾	34¾	32½	34¾	32¾	34¼	33⅝
1900-01	53½	46	49	46¾	48	42	44½	41	41½	34½	37½	34
1899-1900	42	38	41	38	38	35	42	36½	49½	42	49½	43¾
1898-99	30	25	27¾	26	26	23½	26	23½	27½	25¼	29¼	27½
1897-98	27¼	25¾	26	24¾	25	24¼	26¾	24	27¼	25	30½	27¼
1896-97	25½	25	25½	24	24⅛	23⅛	23⅜	22⅛	22¾	22	25	22
1895-96	32	27	27½	26	27½	26½	26½	25	25¼	25	25¾	25
1894-95	26½	26	28	26½	29	28	29½	28	28	26½	26¾	24½
1893-94	30	27½	27¾	26	27	26½	24¾	24½	24½	23	26½	24½
1892-93	34	31	31½	27	28½	27	27½	27	27	25½	26½	25½
1891-92	37¾	35	36¾	35¼	35½	35	35¼	33	35	33	35¼	34
1890-91	38¾	34½	35¾	34	39½	34½	40½	38	39½	37½	37½	36
1889-90	43	38	38	35¼	36¼	34¼	39	34½	42½	39	45¾	42½
1888-89	36½	32	34½	32	34¼	32½	34	31¾	35	33½	39¼	34½
1887-88	36½	33	35	30½	32½	30¾	30¾	28	30	29	30½	29
1886-87	41	32½	33	28½	30½	28½	32½	29½	34	31	36	33½
1885-86	29½	27	30¾	28¾	35	31	35½	34	34	31½	32½	30
1884-85	31	28	30½	28½	29	27	31	27	30	28	28½	27
1883-84	45	39½	39	32½	35½	31	34	32½	40	34	39	36½

YEAR	Oct.		Nov.		Dec.		Jan.		Feb.		March		Season	
	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low
1919-20	1.63	1.42	1.68	1.55	1.60¼	1.51	1.92	1.61¾	1.97	1.81	2.30	1.96	2.30	70
1918-19	64	57½	78	64½	66½	63½	72¼	66	66½	63½	70	64	78	35½
1917-18	49¾	45	49½	45¾	45½	42½	47	43	44	41	41	36	49¾	36
1916-17	45	43¼	50	45½	53¼	49½	54	51	49	48	48½	41½	54	35½
1915-16	54½	37¾	57	48	54½	50½	56½	54	55	50	52	48¼	57	35¼
1914-15	*	*	45½	44½	45	41½	45	40¾	44¾	41¼	44	42	47½	40¾
1913-14	42¼	38¼	44½	42	43½	43¼	48	43¼	48½	43	47½	44	48½	34¾
1912-13	41	38	39	33¾	40¼	34½	42	38¾	43½	41	43½	36¾	50	33¾
1911-12	50¼	46	46	44¼	50¼	46¼	51	46¼	47¾	46	50¼	46½	1.02	44¼
1910-11	77¾	72	77	74½	77	74	84	77	88	83¼	1.07	87¾	1.07	55¼
1909-10	59½	56½	56¼	53½	56	52½	60½	56	60	59	60¾	58½	60¾	35½
1908-09	37½	35	39½	36½	39½	37¾	42	38½	42	38	39½	36½	50½	35
1907-08	53	50	49½	42	45¾	40	54	40	52¼	46½	57	48	69	40
1906-07	66¾	62	67¾	65½	67½	66	71	66¾	72	70¾	74¾	69	74¾	56¾
1905-06	69¾	66¼	69¾	60	65½	61	65½	63½	69	65	70	66	79	53
1904-05	52¾	51	51	46¾	50½	46½	53½	50	52½	49	57	50½	57	46½
1903-04	57½	55	56½	56	56¼	56	65	56¼	64	59	60	57	65	45
1902-03	53½	48	52¼	50	52½	50	62	52½	65	62½	65	65	65	42
1901-02	36½	33¾	35½	35	36¾	35¼	43	36½	42¾	40	53	41	53	31
1900-01	41	36½	41¼	39	39	35	38	35	39¼	36½	39	34	53½	34
1899-1900	50½	48	49½	47	49½	47¾	52½	50	54	52½	54½	52	54½	35
1898-99	35½	28½	37	33¾	44	36½	44	39½	44	42	45	38	45	23½
1897-98	32	28½	30½	28½	31	30⅜	32½	30¾	34½	32	39	27½	39	24
1896-97	26¾	24⅜	26	24½	25½	24½	25¾	25⅛	27½	25½	27¾	26½	27¾	22
1895-96	25¾	25⅜	25¼	25	28¼	25	30	27	27¼	26½	27	25	32	25
1894-95	26¼	25	25½	25	25¼	25	27½	25¼	31½	27	35	31½	35	24½
1893-94	28	25½	28	26½	28	26	28½	27¼	31¼	28¼	30	26½	31¼	23
1892-93	29	26	29	28½	28½	27½	31	28	33	30½	35	30	35	25½
1891-92	34½	33	33	31½	32½	30½	32	30½	41	31¼	40	32½	41	30½
1890-91	38¾	36¼	39½	36	36	34½	38½	34¾	38½	36½	38½	37	40½	34
1889-90	46	44¾	45	41½	42½	40½	42¼	38½	41¼	39	41	37½	46	34¼
1888-89	43	38½	44	41½	43¾	43	44¼	43	47	43½	51	44	51	31¾
1887-88	33	30	35	33¼	36¼	34	41	36¼	39	37	38	35	41	28
1886-87	35	34	34	33	35	33	38	35½	37	36	36¾	34	41	28½
1885-86	34½	31	35	33	35¼	34	40	35	46	39½	49½	35	49½	27
1884-85	28	27	29½	27	28½	27½	28	27	30	27	30	29	31	27
1883-84	37½	33½	35½	33½	33	30	33½	31	35	32	33	29½	45	29½

*Market nominal for three months after breaking out of "World War."

Lowest quotation in the 37 years 22 cents on August 4, Sept. 4, 5, 8, 1896.

Highest quotation in the 37 years $2.30 on March 31, 1920.

HIGH AND LOW PRICES OF PALE GRADES OF ROSINS AT SAVANNAH, GA., FOR EACH MONTH FOR TEN YEARS.

WATERWHITE GRADE

Month	1919-20		1918-19		1917-18		1916-17		1915-16		1914-15		1913-14		1912-13		1911-12		1910-11	
	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low
April	$14.75	$14.25	$ 7.40	$ 6.90	$6.30	$5.80	$5.60	$5.25	$5.80	$5.55	$6.00	$5.65	$6.50	$6.25	$7.75	$6.65	$8.62½	$7.72½	$7.05	$5.90
May	14.35	13.10	8.85	6.90	6.45	6.00	5.75	5.20	5.80	5.50	6.00	5.65	6.85	6.50	7.75	6.90	8.00	7.30	6.15	5.85
June	17.60	13.50	10.80	8.40	7.15	6.20	6.35	5.90	6.55	5.70	7.05	5.85	6.55	6.30	7.65	7.40	7.40	7.20	6.40	5.90
July	23.00	17.60	11.50	10.50	7.10	6.60	7.00	6.00	6.60	5.90	6.50	5.75	6.50	6.30	7.75	7.80	7.40	6.90	7.35	5.90
August	24.25	21.90	14.00	11.60	7.35	6.75	6.95	6.40	6.00	5.65	......	......	6.50	6.25	8.00	7.60	7.50	6.90	7.05	6.20
Sept.	23.75	22.05	15.25	14.00	7.75	7.15	6.75	6.50	6.20	5.70	......	......	6.30	6.15	8.25	8.15	7.40	7.20	7.25	6.55
October	23.25	20.75	15.75	15.25	7.70	7.50	6.70	6.35	6.60	6.00	......	......	6.50	6.15	8.60	8.25	7.50	7.25	7.20	7.00
November	22.75	22.00	16.90	16.00	7.80	7.50	7.20	6.70	7.50	6.50	6.00	5.90	6.80	6.50	8.60	7.45	7.75	7.50	7.65	7.15
December	21.75	21.25	16.90	16.75	7.75	7.55	7.30	7.20	7.50	7.00	5.90	5.70	7.00	6.80	7.45	7.45	7.75	7.75	7.75	7.20
January	22.10	21.25	16.75	16.65	7.80	7.50	7.32½	6.90	7.75	7.25	5.80	5.70	6.90	6.50	7.80	7.25	7.85	7.35	8.05	7.35
February	20.75	17.75	16.75	16.75	7.70	7.50	6.90	6.65	7.50	6.50	5.80	5.50	6.80	6.45	7.60	7.15	7.50	7.35	8.10	8.05
March	19.50	18.25	16.75	16.75	7.50	7.40	6.70	5.60	6.50	5.52½	5.60	5.50	6.50	6.20	7.85	7.40	7.75	7.40	8.57½	8.10
Season	24.25	13.10	16.90	6.90	7.80	5.80	7.32½	5.20	7.75	5.50	7.05	5.50	7.00	6.15	8.60	6.65	8.62½	6.90	8.57½	5.85

WINDOWGLASS GRADE

Month	1919-20		1918-19		1917-18		1916-17		1915-16		1914-15		1913-14		1912-13		1911-12		1910-11	
	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low
April	$14.50	$14.15	$ 7.30	$ 6.50	$6.20	$5.75	$5.50	$5.10	$5.70	$5.45	$5.80	$5.65	$6.25	$6.00	$7.70	$6.60	$8.62½	$7.72½	$6.95	$5.75
May	14.25	12.75	8.80	6.70	6.40	6.00	5.55	5.05	5.70	5.35	5.95	5.65	6.70	6.25	7.75	6.85	7.95	7.30	6.90	5.70
June	17.30	13.25	10.65	8.20	7.00	6.15	6.00	5.40	6.40	5.60	6.95	5.75	6.45	6.25	7.55	7.40	7.35	7.12½	6.25	5.70
July	22.50	17.25	11.50	10.45	6.95	6.35	6.65	5.80	6.30	5.80	6.25	5.65	6.35	6.25	7.55	7.30	7.30	6.75	7.30	5.70
August	23.95	21.40	13.75	11.45	7.15	6.50	6.80	6.40	5.80	5.45	......	......	6.25	6.00	7.75	7.25	7.25	6.85	7.10	5.80
September	23.25	21.30	15.10	13.60	7.55	7.00	6.60	6.45	6.00	5.55	......	......	6.15	6.00	8.00	7.75	7.25	6.95	7.20	6.30
October	22.75	20.25	15.70	15.15	7.55	7.40	6.50	6.30	6.00	5.80	......	......	6.35	6.00	8.35	8.00	7.20	7.00	7.00	6.60
November	22.10	21.00	16.80	15.75	7.65	7.40	7.00	6.45	7.25	6.25	5.75	5.60	6.50	6.35	8.25	7.35	7.50	7.20	7.55	7.00
December	21.00	20.00	16.80	16.45	7.60	7.45	7.05	6.90	7.25	6.75	5.75	5.60	6.75	6.45	7.35	7.35	7.50	7.50	7.65	7.10
January	21.20	20.25	16.50	16.30	7.50	7.40	7.10	6.70	7.40	7.00	5.70	5.60	6.55	6.25	7.35	7.20	7.65	7.35	8.00	7.30
February	26.50	17.75	16.30	16.30	7.60	7.40	6.70	6.45	7.20	6.25	5.70	5.40	6.50	6.05	7.35	7.10	7.40	7.30	8.05	8.00
March	19.00	18.00	16.30	16.30	7.40	7.30	6.45	5.55	6.25	5.45	5.55	5.45	6.05	5.85	7.75	7.00	7.70	7.30	8.57½	8.05
Season	23.95	12.75	16.80	6.50	7.65	5.75	7.10	5.05	7.40	5.35	6.95	5.40	6.75	5.85	8.35	6.60	8.62½	6.75	8.57½	5.70

N GRADE

Month	1919-20		1918-19		1917-18		1916-17		1915-16		1914-15		1913-14		1912-13		1911-12		1910-11	
	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low
April	$14.30	$14.00	$ 6.50	$ 6.00	$6.15	$5.70	$5.45	$4.90	$5.15	$5.50	$5.40	$5.30	$6.05	$5.80	$7.65	$6.55	$8.62½	$7.70	$6.70	$5.65
May	14.10	12.50	8.50	6.10	6.35	5.95	5.45	4.75	5.15	4.90	5.50	5.20	6.35	6.00	7.50	6.95	7.92½	7.20	5.75	5.40
June	17.10	13.00	10.50	7.95	6.95	6.10	5.90	5.30	5.45	5.00	6.65	5.35	6.15	5.85	7.50	7.40	7.30	7.00	6.00	5.40
July	21.50	17.00	11.45	10.40	6.75	6.20	6.60	5.50	5.45	4.80	6.00	5.25	5.50	5.25	7.50	7.10	7.20	6.55	7.25	5.45
August	23.00	20.90	18.25	11.35	6.70	6.20	6.60	6.30	4.95	4.70	......	......	5.35	5.10	7.35	7.00	6.85	6.45	6.80	5.70
September	22.25	20.80	14.85	13.40	7.35	6.75	6.50	6.30	5.20	4.70	......	......	5.25	5.00	7.50	7.25	6.90	6.65	7.20	6.25
October	22.00	19.75	15.40	14.90	7.35	7.10	6.47½	6.20	6.00	4.90	......	......	5.50	5.10	7.75	7.50	6.87½	6.60	6.90	6.45
November	21.10	19.85	16.70	15.50	7.55	7.25	6.80	6.40	7.00	5.80	5.45	5.40	6.20	5.85	7.60	7.25	6.80	6.65	7.20	6.70
December	20.50	19.75	16.70	16.20	7.40	7.25	6.95	6.70	7.00	6.50	5.50	5.20	6.40	6.25	7.25	7.25	7.40	6.80	7.50	7.00
January	20.90	20.00	16.35	16.30	7.30	7.15	7.02½	6.60	7.25	6.50	5.30	5.20	6.35	6.10	7.25	7.15	7.55	7.25	7.85	7.00
February	20.25	17.50	16.30	16.30	7.40	7.20	6.60	6.30	6.75	6.00	5.30	5.00	6.30	5.80	7.25	7.05	7.30	7.25	8.00	7.90
March	19.00	17.75	16.30	16.30	7.25	7.15	6.35	5.50	6.00	5.30	5.05	4.95	5.80	5.40	7.45	6.75	7.65	7.30	8.57½	8.00
Season	23.00	12.50	16.70	6.00	7.55	5.70	7.02½	4.75	7.25	4.70	6.65	4.95	6.40	5.00	7.75	6.55	8.62½	6.45	8.57½	5.40

HIGH AND LOW PRICES OF MEDIUM GRADES OF ROSINS AT SAVANNAH, GA., FOR EACH MONTH FOR TEN YEARS.

M GRADE

Month	1919-20		1918-19		1917-18		1916-17		1915-16		1914-15		1913-14		1912-13		1911-12		1910-11	
	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low
April	$14.25	$13.25	$ 6.25	$ 5.70	$6.10	$5.65	$5.40	$4.60	$4.45	$4.00	$4.90	$4.50	$5.50	$5.50	$7.60	$6.50	$8.55	$7.70	$6.70	$5.60
May	13.40	12.25	8.20	5.90	6.25	5.90	5.30	4.50	4.45	3.90	4.80	4.60	5.65	5.50	7.45	6.92½	7.92½	7.05	5.60	5.20
June	16.75	12.55	10.40	7.65	6.40	5.85	5.75	5.25	4.45	3.95	5.75	4.60	5.40	5.15	7.45	7.30	7.10	6.80	5.55	5.20
July	21.00	16.50	11.35	10.20	6.00	5.50	6.55	5.45	4.45	4.00	5.10	4.50	5.00	4.30	7.30	6.82½	6.90	6.40	7.00	5.40
August	21.75	20.50	13.10	11.15	5.90	5.60	6.50	6.30	4.20	3.90	......	......	4.50	4.30	7.15	6.80	6.67½	6.30	6.60	5.65
September	21.25	19.80	14.60	13.20	6.55	5.75	6.45	6.25	4.60	4.10	......	......	4.50	4.30	7.15	6.55	6.75	6.40	6.87½	6.30
October	21.00	19.00	15.25	14.70	6.65	6.32½	6.40	6.20	5.70	4.50	......	......	4.60	4.30	7.20	6.60	6.87½	6.40	6.85	6.30
November	21.10	19.00	16.60	15.40	7.15	6.60	6.70	6.35	6.70	5.55	4.80	4.65	5.25	4.75	7.00	6.95	6.60	6.45	6.75	6.50
December	19.25	18.60	16.50	16.15	7.02½	6.85	6.65	6.30	6.50	6.20	4.70	4.25	5.55	5.25	7.05	7.00	7.40	6.60	7.20	6.85
January	20.60	19.00	16.30	16.15	7.05	6.75	6.75	6.35	6.50	6.20	4.40	4.25	5.70	5.20	7.15	6.95	7.50	7.20	7.60	7.00
February	20.00	17.25	16.25	16.25	7.10	6.75	6.35	6.10	6.30	5.60	4.25	4.00	5.30	5.00	7.20	7.00	7.25	7.20	7.95	7.80
March	19.00	17.60	16.25	16.25	6.75	6.75	6.20	5.40	5.75	5.15	4.05	3.95	5.00	4.60	7.40	6.50	7.60	7.25	8.47½	7.95
Season	21.75	12.25	16.60	5.70	7.15	5.50	6.75	4.50	6.70	3.90	5.75	3.95	5.70	4.30	7.60	6.50	8.55	6.30	8.47½	5.20

K GRADE

Month	1919-20		1918-19		1917-18		1916-17		1915-16		1914-15		1913-14		1912-13		1911-12		1910-11	
	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low
April	$13.25	$13.00	$ 6.05	$ 5.50	$6.00	$5.65	$5.30	$4.20	$3.95	$3.25	$4.55	$4.10	$5.45	$5.00	$7.50	$6.50	$8.55	$7.70	$6.30	$5.40
May	13.20	12.00	8.10	5.65	6.25	5.90	5.30	4.30	3.95	3.25	4.45	4.30	5.20	5.00	7.45	6.90	7.90	7.00	5.40	5.00
June	16.50	12.30	10.10	7.55	6.20	5.75	5.65	5.20	3.90	3.30	4.75	4.30	4.90	4.55	7.45	7.20	7.07½	6.65	5.40	5.15
July	19.95	16.35	11.25	10.00	5.75	5.15	6.50	5.40	3.85	3.42½	4.55	4.15	4.80	4.00	7.20	6.75	6.70	6.40	6.35	5.40
August	20.75	19.50	13.00	11.00	5.45	5.25	6.50	6.20	3.55	3.25	......	......	4.25	3.90	7.00	6.60	6.67½	6.30	6.20	5.60
September	21.25	18.85	14.50	13.00	6.35	5.35	6.35	6.20	3.70	3.30	......	......	4.20	4.00	6.75	6.40	6.70	6.35	6.77½	6.20
October	20.50	18.00	15.10	14.50	6.45	6.20	6.40	6.20	5.00	3.55	......	......	4.35	4.10	6.75	6.32½	6.65	6.40	6.65	6.20
November	20.40	18.25	16.60	15.25	6.95	6.47½	6.60	6.35	6.30	5.00	4.30	4.00	4.50	4.25	6.60	6.40	6.50	6.30	6.60	6.25
December	18.50	18.00	16.25	15.70	6.85	6.50	6.45	6.20	6.15	5.75	4.00	3.75	4.75	4.50	6.50	6.30	7.35	6.45	6.75	6.60
January	19.75	18.35	15.90	15.75	6.85	6.50	6.62½	6.20	6.05	5.85	3.95	3.60	4.75	4.35	6.75	6.25	7.37½	6.95	7.10	6.60
February	19.25	16.75	15.75	15.75	6.75	6.25	6.30	6.00	5.90	5.25	3.60	3.20	4.45	4.15	7.00	6.60	7.10	6.95	7.90	7.30
March	18.75	17.50	15.75	15.75	6.25	6.05	6.20	5.40	5.55	5.00	3.30	3.20	4.40	4.00	7.15	6.25	7.30	7.00	8.50	7.90
Season	21.25	12.00	16.60	5.50	6.95	5.15	6.62½	4.20	6.30	3.25	4.75	3.20	5.45	3.90	7.50	6.25	8.55	6.30	8.50	5.00

I GRADE

Month	1919-20		1918-19		1917-18		1916-17		1915-16		1914-15		1913-14		1912-13		1911-12		1910-11	
	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low
April	$12.10	$11.70	$ 5.50	$ 5.25	$6.05	$5.60	$5.05	$4.20	$3.75	$3.10	$4.30	$4.10	$4.80	$4.40	$7.35	$6.50	$8.55	$7.67½	$5.40	$4.95
May	11.80	10.90	7.80	5.50	6.25	5.80	5.25	4.20	3.75	3.10	4.30	4.10	4.90	4.80	7.40	6.80	7.87½	6.95	5.10	4.95
June	15.65	11.00	10.10	7.45	5.90	5.70	5.40	5.00	3.50	3.12½	4.40	4.10	4.75	4.15	7.45	7.05	7.05	6.50	5.40	5.00
July	18.95	15.30	10.40	9.95	5.65	5.10	6.50	5.30	3.50	3.10	4.05	3.55	4.75	3.90	7.10	6.70	6.65	6.35	6.20	5.37½
August	19.75	18.25	12.25	10.50	5.35	5.15	6.50	6.15	3.30	3.05	......	......	4.10	3.85	6.90	6.55	6.67½	6.30	6.17½	5.50
September	19.50	17.90	14.35	12.15	6.20	5.30	6.30	6.15	3.50	3.07½	......	......	4.05	3.50	6.62½	6.40	6.65	6.30	6.67½	6.05
October	20.00	17.00	14.80	14.4[illegible]	6.25	6.00	6.37½	6.15	4.75	3.45	......	......	3.75	3.55	6.60	6.30	6.65	6.37½	6.55	5.95
November	19.35	17.50	15.85	14.60	6.70	6.15	6.50	6.35	5.85	4.55	3.85	3.55	3.95	3.65	6.35	5.72½	6.55	6.15	6.25	5.85
December	17.50	16.75	15.35	13.65	6.42½	6.05	6.40	6.10	5.90	5.10	3.55	3.40	4.05	3.65	6.25	5.40	7.20	6.25	6.40	5.95
January	18.75	16.90	13.90	13.60	6.45	6.10	6.50	6.20	5.95	5.30	3.60	3.30	4.25	3.85	6.30	5.50	7.25	6.45	6.80	6.10
February	18.45	16.70	13.65	13.65	6.30	5.90	6.30	5.85	5.50	5.00	3.25	3.05	4.30	4.20	6.75	6.10	6.80	6.55	7.60	6.90
March	18.45	17.40	13.65	13.65	6.05	5.45	6.20	5.25	5.40	4.90	3.15	3.07½	4.25	3.95	6.85	5.20	7.15	6.80	8.50	7.60
Season	20.00	10.90	15.85	5.25	6.70	5.10	6.50	4.20	5.95	3.05	4.40	3.05	4.90	3.50	7.45	5.20	8.55	6.15	8.50	4.95

HIGH AND LOW PRICES OF COMMON GRADES OF ROSINS AT SAVANNAH, GA., FOR EACH MONTH FOR TEN YEARS.

H GRADE

Month	1919-20		1918-19		1917-18		1916-17		1915-16		1914-15		1913-14		1912-13		1911-12		1910-11	
	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low
April	$12.00	$11.50	$ 5.45	$ 5.25	$5.95	$5.60	$4.90	$4.15	$3.95	$3.25	$4.25	$3.97½	$4.70	$4.30	$7.30	$6.50	$8.47½	$7.65	$5.25	$4.90
May	11.70	10.70	7.75	5.45	6.20	5.80	5.05	4.10	3.75	3.10	4.20	3.95	4.80	4.70	7.40	6.77½	7.82½	6.90	5.05	4.70
June	15.50	10.75	10.10	7.40	5.90	5.60	5.35	4.95	3.50	3.05	4.35	4.02½	4.75	4.00	7.40	7.05	7.10	6.50	5.40	5.00
July	18.45	15.20	10.25	9.85	5.60	5.00	6.50	5.27½	3.45	3.10	4.05	3.55	4.70	3.80	7.05	6.70	6.65	6.35	6.17½	5.32½
August	19.10	17.70	12.20	10.47½	5.35	5.15	6.50	6.15	3.30	3.05	......	......	4.05	3.80	6.82½	6.50	6.67½	6.30	6.15	5.40
September	18.45	16.50	14.30	12.20	6.15	5.27½	6.30	6.10	3.47½	3.05	......	......	4.00	3.50	6.62½	6.40	6.65	6.30	6.67½	6.10
October	18.80	15.50	14.55	14.25	6.22½	6.00	6.35	6.15	4.75	3.40	......	......	3.75	3.50	6.60	6.27½	6.65	6.40	6.50	5.90
November	17.85	16.55	15.70	14.55	6.62½	6.10	6.45	6.32½	5.82½	4.55	3.65	3.37½	3.90	3.60	6.30	5.70	6.55	6.15	6.10	5.75
December	16.60	16.00	15.10	13.00	6.42½	6.00	6.35	6.05	5.90	5.10	3.47½	3.20	3.77½	3.55	6.20	5.40	7.12½	6.22½	6.10	5.70
January	18.75	16.70	13.45	12.95	6.40	6.05	6.40	6.20	5.90	5.25	3.35	3.25	4.20	3.72½	6.27½	5.40	7.22½	6.47½	6.77½	6.10
February	18.35	16.45	13.30	13.30	6.27½	5.90	6.30	5.85	5.35	4.80	3.20	3.05	4.17½	3.90	6.60	6.05	6.77½	6.55	7.40	6.80
March	18.40	17.30	13.30	13.30	6.05	5.45	6.20	5.25	5.35	4.80	3.12½	3.05	4.10	3.95	6.65	5.15	7.15	6.72½	8.45	7.40
Season	19.10	10.70	15.70	5.25	6.62½	5.00	6.50	4.10	5.90	3.05	4.35	3.05	4.80	3.50	7.40	5.15	8.47½	6.15	8.45	4.70

G GRADE

Month	1919-20		1918-19		1917-18		1916-17		1915-16		1914-15		1913-14		1912-13		1911-12		1910-11	
	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low
April	$11.90	11.42½	$ 5.40	$ 5.25	$5.95	$5.50	$4.90	$4.15	$3.70	$3.05	$4.15	$3.85	$4.70	$4.25	$7.27½	$6.50	$8.45	$7.62½	$5.17½	$4.85
May	11.60	10.50	7.70	5.45	6.20	5.80	5.00	4.10	3.65	3.05	4.15	3.87½	4.75	4.70	7.40	6.85	7.77½	6.85	4.97½	4.60
June	15.45	10.70	10.10	7.40	5.85	5.55	5.35	4.95	3.45	3.05	4.40	4.00	4.75	4.00	7.40	7.05	7.10	6.50	5.35	4.90
July	18.00	15.15	10.25	9.75	5.55	5.00	6.45	5.25	3.45	3.05	4.05	3.55	4.65	3.80	7.05	6.70	6.65	6.30	6.12½	5.30
August	18.60	17.20	12.20	10.30	5.30	5.15	6.40	6.00	3.25	3.00	......	......	4.05	3.77½	6.80	6.45	6.67½	6.30	6.10	5.35
September	18.05	16.30	14.25	12.20	6.10	5.25	6.25	6.05	3.45	3.05	......	......	4.00	3.50	6.60	6.40	6.65	6.30	6.62½	6.05
October	18.60	15.30	14.45	14.15	6.17½	5.95	6.35	6.20	4.75	3.37½	......	......	3.75	3.45	6.60	6.25	6.65	6.37½	6.45	5.85
November	17.35	16.50	15.62½	14.35	6.62½	6.10	6.42½	6.30	5.80	4.55	3.60	3.35	3.85	3.60	6.35	5.65	6.50	6.12½	6.10	5.72½
December	16.55	16.00	15.00	13.00	6.42½	6.00	6.32½	6.05	5.90	5.10	3.47½	3.17½	3.75	3.55	6.17½	5.40	7.12½	6.20	6.10	5.67½
January	18.75	16.60	13.40	12.95	6.40	6.05	6.30	6.05	5.85	5.20	3.30	3.22½	4.20	3.72½	6.25	5.40	7.25	6.47½	6.75	6.00
February	18.35	16.40	13.25	13.25	6.25	5.90	6.30	5.85	5.35	4.80	3.17½	3.05	4.17½	3.90	6.50	6.00	6.75	6.55	7.25	6.77½
March	18.35	17.25	13.25	13.25	6.05	5.45	6.00	5.25	5.35	4.80	3.15	3.05	4.07½	3.85	6.55	5.10	7.15	6.72½	8.40	7.25
Season	18.75	10.50	15.62½	5.25	6.62½	5.00	6.45	4.10	5.90	3.00	4.40	3.05	4.75	3.45	7.40	5.10	8.45	6.12½	8.40	4.60

F GRADE

Month	1919-20		1918-19		1917-18		1916-17		1915-16		1914-15		1913-14		1912-13		1911-12		1910-11	
	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low
April	$11.75	$11.35	$ 5.40	$ 5.25	$5.90	$5.50	$4.80	$3.95	$3.57½	$3.05	$4.12½	$3.82½	$4.75	$4.20	$7.27½	$6.50	$8.45	$7.60	$5.07½	$4.75
May	11.50	10.50	7.70	5.40	6.20	5.75	5.00	4.05	3.55	2.90	4.15	3.85	4.70	4.60	7.40	6.85	7.75	6.80	4.92½	4.50
Jpne	15.40	10.65	10.10	7.40	5.85	5.50	5.35	4.95	3.40	3.00	4.35	4.00	4.75	4.00	7.40	7.05	7.05	6.42½	5.35	4.85
July	17.85	15.00	10.20	9.75	5.50	5.00	6.40	5.25	3.35	3.00	4.05	3.55	4.60	3.80	7.02½	6.70	6.65	6.30	6.05	5.30
August	18.35	16.90	12.00	10.20	5.30	5.15	6.35	5.90	3.15	2.90	......	......	4.00	3.75	6.75	6.45	6.67½	6.30	6.05	5.30
September	17.75	16.00	14.15	12.00	6.05	5.20	6.20	6.05	3.45	3.00	......	......	4.00	3.50	6.60	6.40	6.65	6.30	6.57½	6.05
October	18.30	15.20	14.40	14.10	6.15	5.95	6.35	6.20	4.75	3.35	......	......	3.75	3.45	6.60	6.25	6.65	6.40	6.40	5.80
November	17.35	16.45	15.55	14.25	6.62½	6.10	6.40	6.25	5.80	4.50	3.55	3.35	3.85	3.60	6.35	5.60	6.55	6.12½	6.05	5.70
December	16.55	16.00	15.00	13.00	6.42½	6.00	6.30	6.00	5.90	5.10	3.45	3.15	3.75	3.55	6.17½	5.40	7.10	6.20	6.07½	5.65
January	18.75	16.55	13.35	12.95	6.40	6.05	6.27½	6.05	5.80	5.20	3.27½	3.20	4.20	3.70	6.20	5.32½	7.20	6.47½	6.72½	5.97½
February	18.30	16.35	13.20	13.20	6.25	5.90	6.30	5.85	5.35	4.75	3.15	3.00	4.17½	3.90	6.45	5.95	6.75	6.55	7.20	6.75
March	18.35	17.20	13.20	13.20	6.05	5.45	6.00	5.25	5.30	4.75	3.10	3.05	4.05	3.85	6.50	5.00	7.15	6.72½	8.40	7.20
Season	18.75	10.50	15.55	5.25	6.62½	5.00	6.40	3.95	5.90	*2.90	4.35	3.00	4.75	3.45	7.40	5.00	8.45	6.12½	8.40	4.50

HIGH AND LOW PRICES OF COMMON GRADES OF ROSINS AT SAVANNAH, GA., FOR EACH MONTH FOR TEN YEARS.

E GRADE

Month	1919-20		1918-19		1917-18		1916-17		1915-16		1914-15		1913-14		1912-13		1911-12		1910-11	
	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low
April	$11.65	$11.30	$ 5.40	$ 5.20	$5.90	$5.45	$4.80	$3.90	$3.45	$3.05	$4.00	$3.80	$4.60	$4.15	$7.05	$6.50	$8.40	$7.57½	$4.75	$4.55
May	11.45	10.45	7.70	5.40	6.15	5.65	5.00	3.90	3.45	2.85	4.15	3.80	4.65	4.60	7.30	6.60	7.67½	6.75	4.85	4.40
June	15.35	10.55	10.10	7.40	5.80	5.40	5.30	4.85	3.20	2.90	4.20	3.85	4.60	4.00	6.90	6.70	6.95	6.37½	5.35	4.75
July	17.45	14.75	10.15	9.75	5.40	5.00	6.35	5.05	3.25	2.95	4.05	3.55	4.55	3.70	6.80	6.55	6.50	5.75	5.92½	5.22½
August	18.05	16.75	11.95	10.15	5.30	5.10	6.15	5.75	3.10	2.90	......	......	4.00	3.70	6.65	6.40	6.55	5.55	5.95	5.25
September	17.35	15.85	14.00	11.95	6.05	5.22½	6.10	5.75	3.42½	3.00	......	......	3.90	3.50	6.50	6.25	6.65	6.20	6.45	6.00
October	18.10	15.15	14.35	14.00	6.15	5.95	6.35	6.00	4.75	3.30	......	......	3.75	3.50	6.55	6.20	6.57½	6.35	6.30	5.75
November	17.35	16.40	15.50	14.20	6.62½	6.10	6.35	6.25	5.80	5.40	3.52½	3.30	3.85	3.60	6.22½	5.70	6.50	6.07½	5.95	5.65
December	16.45	16.00	15.00	13.00	6.42½	6.00	6.30	6.00	5.85	5.10	3.42½	3.15	3.80	3.52½	6.15	5.40	7.05	6.15	6.05	5.60
January	18.75	16.50	13.30	12.95	6.40	6.05	6.27½	6.05	5.80	5.20	3.25	3.17½	4.17½	3.70	6.00	5.25	7.20	6.40	6.70	5.95
February	18.25	16.25	13.15	13.15	6.25	5.90	6.30	5.85	5.30	4.75	3.10	3.00	4.15	3.90	6.42½	5.85	6.75	6.50	7.17½	6.72½
March	18.35	17.15	13.15	13.15	6.05	5.45	6.00	5.25	5.20	4.75	3.07½	3.02½	4.00	3.75	6.45	4.90	7.10	6.70	8.40	7.17½
Season	18.75	10.45	15.50	5.20	6.62½	5.00	6.35	3.90	5.85	2.85	4.20	3.00	4.65	3.50	7.30	4.90	8.40	5.55	8.40	4.40

D GRADE

Month	1919-20		1918-19		1917-18		1916-17		1915-16		1914-15		1913-14		1912-13		1911-12		1910-11	
	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low
April	$11.65	$11.30	$ 5.40	$ 5.20	$5.80	$5.40	$4.80	$3.85	$3.40	$3.05	$3.95	$3.75	$4.50	$4.10	$6.95	$6.20	$8.27½	$7.50	$4.50	$4.20
May	11.45	10.40	7.70	5.40	6.05	5.65	4.85	3.90	3.40	2.75	4.00	3.70	4.60	4.50	6.75	6.35	7.55	6.67½	4.55	4.10
June	15.20	10.55	10.10	7.40	5.70	5.35	5.30	4.85	3.10	2.85	4.10	3.80	4.35	3.90	6.60	6.30	6.82½	6.20	5.20	4.30
July	17.45	14.50	10.15	9.75	5.30	5.00	6.35	5.10	3.20	2.87½	4.05	3.52½	4.45	3.60	6.65	6.25	6.25	5.50	5.90	5.10
August	17.85	16.50	11.70	10.10	5.30	5.10	6.05	5.70	3.02½	2.80	......	......	4.00	3.60	6.55	6.35	6.30	5.35	5.85	5.10
September	17.05	15.75	13.80	11.85	6.05	5.22½	5.95	5.70	3.40	3.00	......	......	3.90	3.50	6.45	6.25	6.40	6.15	6.37½	5.85
October	17.80	15.05	14.30	13.90	6.15	5.95	6.35	5.90	4.75	3.25	......	......	3.75	3.50	6.45	6.15	6.50	6.27½	6.30	5.70
November	17.35	16.25	15.45	14.20	6.62½	6.10	6.35	6.25	5.80	4.40	3.52½	3.30	3.85	3.60	6.17½	5.67½	6.35	6.02½	5.95	5.60
December	16.45	16.00	15.00	13.00	6.42½	6.00	6.30	6.00	5.85	5.00	3.40	3.12½	3.75	3.52½	6.10	5.40	7.00	6.10	6.05	5.57½
January	18.75	16.50	13.35	12.95	6.40	6.05	6.27½	6.05	5.80	5.20	3.25	3.15	4.15	3.70	6.00	5.15	7.10	6.35	6.65	5.92½
February	18.25	16.25	13.15	13.15	6.25	5.90	6.30	5.85	5.30	4.75	3.07½	3.00	4.15	3.90	6.40	5.40	6.70	6.45	7.15	6.70
March	18.25	17.00	13.15	13.15	6.05	5.45	6.00	5.25	5.20	4.75	3.05	3.02½	4.00	3.75	6.40	4.90	7.00	6.65	8.25	7.15
Season	18.75	10.40	15.45	5.20	6.62½	5.00	6.35	3.85	5.85	2.75	4.10	3.00	4.60	3.50	6.95	4.90	8.27½	5.35	8.25	4.10

B GRADE

Month	1919-20		1918-19		1917-18		1916-17		1915-16		1914-15		1913-14		1912-13		1911-12		1910-11	
	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low
April	$11.65	$11.10	$ 5.40	$ 5.15	$5.80	$5.40	$4.80	$3.75	$3.30	$3.05	$3.80	$3.50	$4.50	$4.05	$6.85	$6.05	$8.15	$7.40	$4.30	$3.95
May	11.20	10.25	7.70	5.40	6.05	5.65	4.85	3.75	3.30	2.65	3.85	3.45	4.55	4.50	6.60	6.00	7.40	6.37½	4.40	3.75
June	15.05	10.30	10.10	7.40	5.65	5.30	5.30	4.75	3.05	2.65	4.00	3.55	4.00	3.60	6.35	5.85	6.50	5.60	5.05	4.10
July	16.85	14.00	10.15	9.75	5.30	5.00	6.30	5.00	3.10	2.75	3.90	3.50	4.35	3.45	6.37½	5.65	5.75	5.10	5.90	5.00
August	17.05	15.75	11.60	10.05	5.30	5.05	5.95	5.45	2.95	2.80	......	......	4.00	3.45	6.40	6.25	6.07½	5.05	5.75	5.05
September	16.10	15.25	13.80	11.50	6.05	5.22½	5.95	5.60	3.40	2.95	......	......	3.90	3.50	6.40	6.25	6.25	5.95	6.37½	5.80
October	17.50	14.90	14.30	13.75	6.15	5.85	6.35	5.85	4.75	3.20	......	......	3.75	3.47½	6.40	6.10	6.45	6.25	6.30	5.65
November	17.35	16.15	15.45	14.10	6.62½	6.10	6.35	6.15	5.80	4.40	3.50	3.30	3.85	3.60	6.12½	5.65	6.35	5.95	5.95	5.55
December	16.45	16.00	15.00	13.00	6.42½	6.00	6.30	6.00	5.85	5.00	3.40	3.07½	3.75	3.52½	6.10	5.40	7.00	6.00	6.05	5.57½
January	18.75	16.45	13.25	12.90	6.40	6.05	6.27½	6.05	5.80	5.20	3.25	3.12½	4.15	3.70	6.00	4.90	7.07½	6.30	6.65	5.95
February	18.90	15.75	13.10	13.10	6.25	5.90	6.30	5.85	5.30	4.75	3.05	2.90	4.15	3.90	6.27½	4.95	6.72½	6.40	7.12½	6.70
March	17.00	16.00	13.10	13.10	6.05	5.40	6.00	5.25	5.20	4.70	3.05	2.90	4.00	3.65	6.25	4.90	6.90	6.62½	8.15	7.12½
Season	18.75	10.25	15.45	5.15	6.62½	5.00	6.35	3.75	5.85	2.65	4.00	2.90	4.55	3.45	6.85	4.90	8.15	5.05	8.15	3.75

THE LIFE OF THE NAVAL STORES INDUSTRY AS AT PRESENT CARRIED ON IN THE SOUTH

(Report of Secretary of Agriculture Meredith to the United States Senate, 1920.)

[One of the most important investigations undertaken by the Agricultural Department of the United States Government in recent years was that made this year under the resolution presented by Senator Capper, and adopted by the U. S. Senate, calling for an investigation and report on the timber resources of this country. An experienced member of the Forest Service was assigned to the investigation of conditions as to the long-leaf pine of the South and the naval stores industry, an investigator well known to many naval stores men. The report is at once comprehensive and concise and the facts presented should not only arouse interest but provide quick, intelligent and combined action to protect the industry from shrinking into one of petty importance. The situation is so serious that it should command the attention of every naval stores man and every owner of long-leaf pine timber.]

So pronounced is depletion of the timber upon which our naval stores industry depends for its supplies that it is commonly regarded as a dying industry in the United States. In colonial days, when the wooden shipbuilding industry of New England was of great importance, naval stores for domestic consumption, as well as for export, were secured from the pitch pine from Maine to New Jersey. The present-day naval stores industry dates back also to early colonial times, but uses the longleaf and slash pines of the South.

The very name of the industry is no longer appropriate, since the bulk of its products—spirits of turpentine and rosin—are largely used for purposes having no connection with shipping. They are important constituents in such products as soap, paint and varnish, paper sizing, printing ink, greases, oils and belt dressing, soldering flux, shoe polishes, roofing and linoleum, fly paper, sealing wax, electrical supplies, matches, and various articles in the drug trade. The annual products of the industry exceed $40,000,000 in value, more than half of which comes from exports. Since the Civil War it has held a place among the industries of the South inferior only to agriculture and lumbering. Since 1820, or in fact since statistics of any value are available, American production has led the world, and even at the present time is approximately 80 per cent. of the total world production.

For the South as a whole, production has been falling off for a number of years. From slightly less than 34,000,000 gallons of turpentine in 1899, the first year of satisfactory statistics, it declined to approximately 17,000,000 gallons in 1918, a decrease of 50 per cent. Rosin production during the same period fell a proportionate amount.

The average production of the last six years has been 25,000,000 gallons of spirits of turpentine and 834,000,000 pounds of rosin, a production which has been easily absorbed by the world's industries.

A study of the opinions and estimates of a number of the best-informed men in the industry, men representing every part of the territory and having more than ordinary means of information, indicates that there are not more than 31,000 crops of turpentine timber available and uncupped in the naval stores territory today. From this amount of timber it is estimated that not more than 166,000,000 gallons of turpentine and 5,000,000,000 pounds of rosin can be produced. In addition to the uncupped supply of timber, that which has been or is now being worked will probably yield 60,000,000 gallons of spirits of turpentine and 1,900,000,000 pounds of rosin, making the total available supply 226,000,000 gallons of spirits of turpentine and 6,900,000,000 pounds of rosin. Our own markets and export demands will, it is believed, absorb 25,000,000 gallons of spirits and 825,000,000 pounds of rosin annually. At this rate the supply of timber now in sight would be exhausted in less than 10 years. It will actually be extended beyond this period by the production of wood turpentine and rosin and also by the gradual falling off in the rate of production as the remaining timber supplies become exhausted. The indications are, however, that the production of gum naval stores in the southern pine belt will within 10 years have been reduced to such an extent that export markets and even our own must look elsewhere for their main supplies.

The naval stores industry of the South has migrated from State to State, following the timber. North Carolina, where now production is negligible, was for many years the leading State. South Carolina has been practically abandoned by the industry for more than 20 years. Rising prices have induced a few operators to go back over the territory to work scattered second-growth stands and isolated patches of virgin timber, but it seems probable that these supplies will be exhausted within four years. Well-informed men in the industry believe that in from four to six years under present demands Georgia will take its place with North and South Carolina as an insignificant factor in production.

Florida has been the mainstay of naval stores production during the last 10 years, but the end of its supply is definitely in sight. Of late the value of its product has been more than twice as much as that of any other State, and nearly half the value of the naval stores produced in all Southern States. Fairly accurate data on the resources of Florida have been compiled by some of the large naval stores interests. This information, checked by estimates of well-informed operators in various parts of the State, indicates that at the cur-

rent rate of production Florida can not hold its own for more than eight years. That the State will soon be brought to the position of North and South Carolina and Georgia is improbable, since a very considerable portion of the remaining timber is held by strong corporations in large, well-blocked bodies, and it is to be expected that exploitation will be more conservative and less wasteful and hurried. It is the opinion of the well-informed men in the Florida industry that not more than 5,000 crops of uncupped timber available for operation remain in the State.

Much of the long leaf and slash pine of Alabama has already been worked, and the greater portion of the remaining stand of uncupped timber is in the hands of large lumber companies. Turpentine operators, judging from the present rate of lumbering, foresee a possible increase in production for the next three years, followed by a very rapid reduction. They believe that the State will be practically eliminated as a large producer of naval stores within five years. General opinion places remaining stands at not more than 1,000 crops, including all second growth now merchantable.

Well-informed observers believe that Mississippi will show an increase in production during the next four or five years. The timber, however, both here and in Louisiana and Texas, is largely owned by lumbermen who will force a rapid exploitation for naval stores in order that the lumbering may not be delayed. Five thousand crops of uncupped timber are estimated. It is predicted that the crest of production will have been passed within five years, and that this will be followed by a rapid decline. Within eight years Mississippi will not be a leading State in naval stores production.

The industry is comparatively new in Louisiana. The timber is largely held by lumbermen who excluded naval stores operations very generally until four or five years ago. Much of the timber has been and some of it is still being cut unturpentined. The average turpentine lease on many of these large holdings does not exceed two years in length. Of the 27 billion feet of long leaf pine in Louisiana the removal of 20 billion feet for lumber is predicted during the next 10 years. A yield of not to exceed 13,500 crops is anticipated. Operators familiar with the situation agree that 10 years will probably see the beginning of a very rapid decline in production from Louisiana, and 15 years the end of the present supply.

Sawmills will probably remove 7,500 million feet of the 11 billion feet of long leaf pine in Texas during the next 10 years, and Texas is the last stand of the turpentine industry in the South. Naval stores production in Texas will be increased rapidly as the Eastern States are exhausted, but operations will be seriously curtailed by the desire of timber owners to exploit the stands for lumber. The naval stores industry estimates that there are not more than 4,600 crops in Texas and predicts practical exhaustion within 10 years.

While the rate of depletion of the supply of naval stores timber has been greatly accelerated during the last few years by the rapid cutting of timber controlled by lumber interests, the naval stores operators themselves are responsible for the fact that what was once the largest and finest naval stores forest in existence is about to become a matter of history. The method of exploitation commonly followed during the last hundred years is crude, wasteful, destructive, and sadly shortsighted. Under the driving urge of maximum financial returns in a minimum of time, regardless of after effects, turpentine orchards even today are operated so destructively that the trees are exhausted in from four to six years and turned over to the sawmill man showing a loss due to turpentining of from 20 to 50 per cent.

That quick exhaustion of the turpentine productivity of the tree, and, in many cases, its early destruction, is not a necessity in the production of naval stores is shown by the French naval stores industry. For the last 80 years a system of operation has been followed in France that permits an orchard to be worked for turpentine for from 30 to 50 years, practically without loss of timber. Coupled with this admirable system of operation is a plan of management under which a crop of new timber is continually growing into maturity to fill the gap left by the harvesting of mature timber. As a result of such foresight the French supply of naval stores is increasing yearly, both in value and in amount.

Conservative methods of turpentining in southern pine forests have been developed by the Forest Service and are now in commercial use on the Florida National Forest, and on private holdings of some of the more progressive operators. Inertia, not financial obstacles, must be regarded as the chief reason why these conservative methods have not been more generally employed. They make entirely possible, when combined with intelligent forest management, a permanent as against a self-destroying industry.

As in the case of lumber and newsprint, the superficial cause of abnormal prices is a combination of abnormal demand and shortage of the manufactured product. The stocks of turpentine and rosin at the chief points of concentration were lower at the end of the last naval stores season than has been the case in many years. At the same time the demand, both foreign and domestic, has been stronger than at any other time during the past five years. The natural result has been keen competition for supplies on hand and consequent rise in price. As in the case of lumber and other industries, there have been increased costs. It has been difficult to secure adequate supplies of skilled labor. Credit inflation alone would have increased prices, but the fundamental difficulty has been the depletion of the timber supplies from which naval stores can be secured and the great limitation of the producing regions already discussed. The price of spirits of turpentine, which for very many years fluctuated slightly above and below 50 cents a gallon, had risen nearly five times to a price of $2.30 early in 1920, and similar increases occurred in prices for various grades of rosin.

With a prospective reduction in domestic production, the United States is facing in the near future rapidly decreasing ability to export naval stores products, and even within a few years to meet home demands from the southern pine territory. There are possibilities of development of the industry with other species in the West, but under much more adverse conditions as to accessibility, labor, etc. The only other possibilities are imports or the use of substitutes.

THE WORLD-WIDE DISTRIBUTION OF NAVAL STORES

WITH STATEMENTS OF EXPORTS COMPILED FROM OFFICIAL SOURCES

(By Thomas Gamble.)

IN THE following tables the world-wide distribution of spirits turpentine and rosins for a term of years is given as concisely as possible. They thoroughly illuminate the fact that these commodities are in use in practically every country of the globe that makes any pretensions to an industrial life, and have become a factor in the trade of the United States with probably every nation with which it has commercial relations.

The several statements are so complete and so detailed that any extended comments are rendered unnecessary. Even a casual study shows the tremendous loss that was inflicted on consumption by the curtailment of trade with the principal customers for naval stores during the World War and the disorganization that still exists in Europe.

Russia and Austria have literally been "wiped from the map" as consuming customers for rosins, although in the years prior to the war the trade with them aggregated an annual average of 100,000 barrels. Germany, from being one of the largest, if not actually the largest, consumer of naval stores from this country, with average direct annual importations of over 400,000 barrels rosin and nearly 60,000 barrels spirits turpentine, has sunk for the time being to the position of a petty purchaser; reduced, in fact, to such an extent in its demands for this season, and in all likelihood for the next year or two as well, as to be practically dismssed from calculations as a factor of any moment. Italy has been sadly lessened in buying power, and the Scandinavian countries are, even at the best, but minor users of these commodities.

The United Kingdom, whose average importations for the five crop years preceding 1914 were 133,000 barrels spirits turpentine and 280,000 barrels rosin, is struggling against adverse exchange and other inimical conditions, but constitutes today the largest single consuming customer for these products of the Southern States, outside of our own domestic markets. These are patent facts that impress every one who studies the statistics herewith given showing the movement of naval stores into the world's channels of distribution. South America and Canada give promise of holding their own as consumers of rosins—the homes of expanding industries that will make them more important consumers for that commodity. Canada is a fair buyer of turpentine, it will be noted, but South American industries using it have as yet shown but a meagre development.

A complete survey of the world demonstrates that the re-establishment of foreign naval stores trade on anything approaching the old level hinges upon the cessation of the present agitating convulsions and the restoration of more normal conditions in Continental Europe. Until such conditions do return the demand for naval stores must continue decidedly smaller than before the war, and even if it were possible by extraordinary efforts to increase production in the South until it approximated the old figures it would be sheer economic folly, in view of the greatly increased cost of production, to do so.

With the foreign requirements cut by about fifty per cent. at this time, and a restoration of former demand distant at least for some years, the necessity confronts the producers of so limiting the output as to hold the total American crop within reasonable bounds and not so exceed the world's actual needs as to overstock a sensitive and easily influenced market to the serious financial disarrangement of the industry and a threat of collapse approaching that of three years ago. The recent course of values, owing to the increase in the 1920 crop, and the failure of foreign requirements to expand as had been anticipated, has been unsatisfactory, and the lesson of the relations of supply and demand in their effect on market values is not apt to be overlooked in the coming years.

EXPORTS OF NAVAL STORES FROM UNITED STATES FOR FOURTEEN CROP YEARS, ENDING MARCH 31.

Spirits of Turpentine, in Barrels of Fifty Gallons.

Year	Total Exports	Exported to Europe	Per Cent. to Europe	Exported to Countries Outside of Europe	Per Cent. to Countries Outside of Europe
1919-20	214,000	158,000	73.8	56,000	26.2
1918-19	83,000	18,000	21.7	65,000	78.3
1917-18	107,000	33,000	30.9	74,000	69.1
1916-17	199,000	130,000	65.3	69,000	34.7
1915-16	192,000	123,000	64.1	69,000	35.9
1914-15	236,000	181,000	76.7	55,000	23.3
1913-14	378,000	321,000	84.9	57,000	15.1
1912-13	423,000	353,000	83.5	70,000	16.5
1911-12	377,000	297,000	78.8	80,000	21.2
1910-11	287,000	231,000	80.5	56,000	19.5
1909-10	299,000	248,000	83.0	51,000	17.0
1908-09	327,000	275,000	84.1	52,000	15.9
1907-08	351,000	288,000	82.0	63,000	18.0
1906-07	302,000	257,000	85.1	45,000	14.9

Rosins, in Barrels of 500 Lbs.

Year	Total Exports	Exported to Europe	Per Cent. to Europe	Exported to Countries Outside of Europe	Per Cent. to Countries Outside of Europe
1919-20	730,000	301,000	41.2	429,000	58.8
1918-19	502,000	205,000	40.8	297,000	59.2
1917-18	734,000	278,000	37.9	456,000	62.1
1916-17	946,000	504,000	53.3	442,000	46.7
1915-16	869,000	536,000	61.7	333,000	38.3
1914-15	820,000	602,000	73.4	218,000	26.6
1913-14	1,471,000	1,194,000	81.2	277,000	18.8
1912-13	1,417,000	1,071,000	75.6	346,000	24.4
1911-12	1,422,000	1,085,000	76.3	337,000	23.7
1910-11	1,263,000	968,000	76.6	295,000	23.4
1909-10	1,176,000	919,000	78.1	257,000	21.9
1908-09	1,284,000	1,016,000	79.1	268,000	20.9
1907-08	1,555,000	1,221,000	78.5	334,000	21.5
1906-07	1,518,000	1,070,000	70.5	448,000	29.5

EXPORTS OF SPIRITS TURPENTINE FROM UNITED STATES TO VARIOUS COUNTRIES AND TO THE SEVERAL CONTINENTS FOR TWELVE YEARS, ENDING JUNE 30, AND YEAR ENDING DEC. 31, 1919.

COUNTRY	1906-07	1907-08	1908-09	1909-10	1910-11	1911-12	1912-13	1913-14	1914-15	1915-16	1916-17	1917-18	Dec. 31, 1919
AFRICA	2,047	3,015	1,947	2,185	3,026	2,152	3,493	3,054	2,495	2,558	3,390	1,540	1,280
ARGENTINE	6,419	11,469	7,085	8,454	9,757	12,953	11,011	10,251	9,949	9,189	7,139	6,436	10,568
AUSTRALIA, TASMANIA AND NEW ZEALAND	10,071	11,635	8,955	7,767	15,244	17,161	13,740	9,985	14,177	11,815	16,772	18,855	2,752
AUSTRIA-HUNGARY	40	403	836	799	1,133	2,711	1,379	153					
BELGIUM	39,809	46,599	34,463	44,367	43,896	28,574	37,458	20,547	2,274				6,098
BRAZIL	4,359	4,825	3,871	5,112	5,723	6,685	7,133	6,038	6,264	6,032	6,022	4,447	6,156
CANADA	18,427	17,455	19,295	19,289	21,956	18,412	20,795	22,297	18,358	20,535	22,180	19,562	19,393
CENTRAL AMERICA	1,217	1,223	915	910	968	1,084	916	976	661	1,003	811	1,045	1,519
CHILI	3,362	2,692	2,310	2,176	2,717	3,885	2,620	1,689	1,633	3,159	2,091	4,825	930
COLOMBIA	170	189	222	172	195	235	206	193	195	294	242	192	259
CUBA	2,808	2,763	2,625	2,321	1,220	1,234	1,534	1,313	1,170	1,947	1,508	2,359	1,973
ENGLAND	¶118,953	¶144,346	137,601	106,293	112,908	148,658	139,445	134,351	97,209	102,316	101,392	27,002	116,293
GERMANY	59,985	73,241	62,144	52,353	35,727	56,243	76,984	65,518	3,932				214
IRELAND	**	**		90		200							
ITALY	4,660	9,325	4,618	3,986	1,750	4,887	3,222	400	3,226	2,176	2,553	6,026	9,828
JAPAN	833	1,055	861	23	140	1,021	1,320	398	1,058	1,445	167	1,770	210
MEXICO	165	128	183	115	244	50	90	142	151	205	232	363	946
NETHERLANDS	38,495	53,620	51,248	45,238	31,122	67,590	84,847	87,878	12,515	8,853	1,338		13,473
NORWAY										494	593		1,726
PERU	909	1,027	467	560	694	1,192	851	700	443	820	1,184	900	589
PORTUGAL			69										
RUSSIA									258	20	400		
SCOTLAND	**	**	6,215	6,151	3,818	8,456	9,200	7,846	9,565	8,923	5,149	1,272	8,157
SPAIN					1						10		
SWEDEN					100				150	310	569		2,103
URUGUAY	759	1,086	808	973	1,222	1,282	1,171	961	1,220	1,246	714	992	1,658
VENEZUELA	249	191	211	229	269	282	262	240	223	338	345	349	443
WEST INDIES; Other than Cuba	446	585	484	496	437	469	503	470	353	505	566	706	500

EXPORTS TO THE VARIOUS CONTINENTS IN TOTAL BARRELS—

	1906-07	1907-08	1908-09	1909-10	1910-11	1911-12	1912-13	1913-14	1914-15	1915-16	1916-17	1917-18	Dec. 31, 1919
AFRICA	2,047	3,015	1,947	2,185	3,026	4,152	3,493	3,054	2,495	2,558	3,390	1,540	1,280
ASIA	2,717	4,061	2,273	1,170	1,316	3,332	2,433	2,078	2,333	2,497	994	3,856	2,458
EUROPE	262,005	327,538	297,206	259,178	230,461	317,522	352,537	316,306	129,208	123,096	112,011	34,304	161,683
NORTH AMERICA	23,177	22,357	23,643	23,244	24,927	21,442	24,014	25,411	20,842	24,548	25,422	24,273	24,446
OCEANIA	10,660	11,907	9,765	8,063	15,833	18,672	14,744	10,175	14,352	12,233	17,065	19,487	2,769
SOUTH AMERICA	16,487	21,773	15,206	17,915	20,792	26,815	23,566	20,390	20,052	21,273	17,955	18,442	20,806
TOTAL EXPORTS	317,093	390,651	350,040	311,755	296,355	391,985	420,792	377,414	189,282	186,205	176,837	101,902	213,442

** Included in England.

¶ Including Ireland and Scotland.

EXPORTS OF ROSIN FROM UNITED STATES TO VARIOUS COUNTRIES AND TO THE SEVERAL CONTINENTS FOR TWELVE YEARS ENDING JUNE 30, AND YEAR ENDING DEC. 31, 1919.

COUNTRY	1906-07	1907-08	1908-09	1909-10	1910-11	1911-12	1912-13	1913-14	1914-15	1915-16	1916-17	1917-18	Dec. 31, 1919
AFRICA	2,470	2,034	3,109	2,800	1,918	890	1,683	1,506	1,266	2,144	4,088	10,308	1,469
ARGENTINE	42,912	51,283	59,335	60,330	48,745	68,506	73,520	57,136	80,308	54,491	67,361	83,740	65,357
AUSTRALIA, TASMANIA AND NEW ZEALAND	34,758	43,144	20,885	13,867	19,278	25,032	27,380	28,140	17,188	17,815	28,012	42,766	9,831
AUSTRIA-HUNGARY	58,194	84,666	49,707	35,600	36,207	58,217	47,079	38,169					1,674
BELGIUM	41,171	47,322	37,697	92,415	67,730	91,473	78,967	62,572	44,950				8,189
BRAZIL	73,856	83,489	80,516	82,318	97,335	99,100	101,193	54,688	59,093	74,225	82,579	88,942	86,527
CANADA	41,588	39,304	35,836	37,946	43,154	52,340	49,874	43,156	41,503	67,282	96,644	72,279	39,937
CENTRAL AMERICA	3,004	2,723	2,306	2,770	2,265	2,304	1,772	2,895	5,075	3,249	3,249	1,767	1,998
CHILI	6,779	2,997	5,941	3,999	3,790	3,373	6,391	2,654	1,618	3,430	6,854	7,222	5,800
COLOMBIA	4,217	4,584	3,918	4,166	5,460	7,102	6,743	3,537	2,864	6,239	6,368	7,152	6,240
CUBA	10,291	11,370	11,929	13,078	13,334	14,278	14,025	13,469	16,691	16,143	18,121	19,295	15,176
ENGLAND	¶347,381	¶342,810	206,680	24,554	187,890	238,232	304,195	248,930	227,127	283,181	352,124	134,075	258,327
GERMANY	426,708	498,312	370,338	340,051	414,380	381,627	453,467	447,543	29,865				55
IRELAND	**	**	8,356	5,263	3,642	2,540	1,502	1,820	1,368				801
ITALY	58,552	69,542	60,410	49,087	44,285	57,504	64,971	61,253	52,762	65,934	30,759	5,631	10,343
JAPAN	18,594	10,173	10,376	12,336	13,779	21,044	22,703	8,071	18,674	49,381	31,630	57,725	59,422
MEXICO	951	746	618	544	705	358	383	1,184	806	729	1,203	560	509
NETHERLANDS	141,037	152,493	134,534	110,807	97,926	108,919	127,882	138,510	27,375	10,178	403		13,750
NORWAY		100		2,056	956	682	577	1,319	35,392	54,031	37,697		3,769
PERU	3,294	3,369	3,063	2,818	3,923	3,723	4,635	1,945	880	1,536	3,078	3,330	1,014
PORTUGAL	150	305	208			90	30	52		6			
RUSSIA	73,664	35,442	32,949	33,131	43,697	54,938	80,268	81,006	3,050	39,501	41,285		25
SCOTLAND	**	**	35,252	32,995	32,737	41,147	47,189	32,714	51,811	29,081	24,907	19,911	23,386
SPAIN	5,528	2,193	4,089	2,119	5,143	3,227	9,247		31	31		28	24
SWEDEN			1,990	773	301	1,232	683	100	17,620	29,736	3,776		13,241
URUGUAY	10,013	14,272	18,841	16,859	18,143	16,951	19,639	10,633	13,546	12,879	13,573	12,903	13,387
VENEZUELA	5,505	5,443	4,388	4,552	4,035	4,790	4,733	3,832	3,051	3,408	3,917	2,705	3,962
WEST INDIES, Other than Cuba	2,779	2,502	1,696	1,986	1,205	2,369	2,022	1,311	1,304	1,531	1,925	335	392

EXPORTS TO THE VARIOUS CONTINENTS IN TOTAL BARRELS.

	1906-07	1907-08	1908-09	1909-10	1910-11	1911-12	1912-13	1913-14	1914-15	1915-16	1916-17	1917-18	Dec. 31, 1919
AFRICA	2,470	2,034	3,109	2,800	1,918	890	1,683	1,506	1,266	2,144	4,088	10,308	1,469
ASIA	37,751	16,692	18,378	20,766	26,220	41,570	37,913	13,144	27,214	94,338	84,867	83,060	82,493
EUROPE	1,152,830	1,234,056	943,431	929,272	935,673	1,041,065	1,216,566	1,113,496	494,407	518,697	493,022	160,428	342,606
NORTH AMERICA	59,445	57,336	52,974	57,819	61,011	72,417	69,761	62,351	65,874	89,359	122,280	94,547	58,236
OCEANIA	34,830	43,347	20,977	14,224	19,354	25,217	27,709	28,612	17,489	18,052	28,592	43,806	9,839
SOUTH AMERICA	146,815	165,665	176,430	175,937	182,004	204,539	217,754	134,943	162,247	157,293	184,761	207,571	182,743
*TOTAL EXPORTS	1,434,141	1,519,130	1,215,299	1,200,818	1,226,180	1,335,698	1,571,386	1,354,052	768,497	879,916	917,610	599,720	677,392

** Included in England. ¶ Including Ireland and Scotland.

Quantities and Values of Spirits of Turpentine and Rosins Shipped from the United States for One Hundred and Twenty Years

YEARS	SPIRITS OF TURPENTINE		ROSINS		TOTAL VALUES NAVAL STORES EXPORTS
	BARRELS, 50 GALS.	VALUES	BARRELS, 500 LBS.	VALUES	
1919	213,442	$10,448,234	677,392	$20,433,970	$30,882,204
1918	74,342	2,276,523	436,255	7,551,262	9,827,785
1917	130,347	3,384,920	836,300	10,338,576	13,723,496
1916	190,872	4,596,475	1,031,712	11,325,831	15,922,306
1915	212,371	4,844,252	774,388	6,597,614	11,441,866
1914	222,367	5,188,509	979,160	8,068,224	13,256,733
1913	400,363	8,158,198	1,458,837	13,562,585	21,720,783
1912	416,221	9,371,989	1,361,554	16,376,591	25,748,580
1911	363,953	10,937,262	1,352,646	16,207,988	27,145,250
1910	285,046	9,627,428	1,270,830	12,373,825	22,001,253
1909	321,237	7,779,728	1,111,334	8,211,650	15,991,378
1908	388,663	8,301,747	1,456,661	9,661,029	17,962,776
1907	343,536	10,214,610	1,476,243	11,932,701	22,147,311
1906	323,650	10,320,926	1,389,511	10,416,320	20,737,246
1905	317,896	8,902,101	1,293,754	7,069,084	15,971,185
1904	344,056	9,446,155	1,447,660	6,621,870	16,068,025
1903	327,575	8,014,322	1,342,039	4,817,205	12,831,527
1902	383,555	7,431,248	1,420,139	4,202,104	11,633,352
1901	404,817	7,715,029	1,579,656	4,742,457	12,457,486
1900	361,811	8,554,922	1,326,706	3,796,367	12,351,289
1899	355,231	6,100,419	1,435,408	3,741,581	9,842,000
1898	367,023	5,380,806	1,235,474	3,689,252	9,070,058
1897	346,056	4,447,551	1,360,305	4,688,163	9,135,714
1896	348,631	4,613,811	1,216,875	4,151,748	8,765,559
1895	293,055	3,998,277	1,042,941	3,251,250	7,249,257
1894	252,368	3,437,245	1,107,752	3,285,896	6,723,141
1893	268,309	3,893,436	1,153,268	3,333,367	7,226,803
1892	263,529	4,500,721	1,092,120	3,418,459	7,919,180
1891	244,872	4,668,140	1,002,541	3,467,199	8,135,339
1890	224,978	4,590,931	896,771	2,762,373	7,353,304
1889	193,635	3,777,525	795,322	2,120,422	5,897,947
1888	211,718	3,580,106	835,696	2,273,952	5,854,058
1887	204,197	3,489,895	764,407	2,301,636	5,791,531
1886	164,353	2,811,777	633,674	1,963,091	4,774,868
1885	179,744	2,690,231	710,810	2,198,267	4,888,489
1884	226,014	3,885,500	865,318	2,909,074	6,794,574
1883	197,347	4,366,229	754,463	3,068,132	7,434,361
1882	162,730	3,798,034	647,367	3,240,803	7,038,837
1881	131,910	2,414,719	573,278	2,529,423	4,944,142
1880	141,824	2,132,154	582,593	2,368,180	4,500,334
1879	151,511	2,045,673	623,177	2,159,141	4,204,814
1878	152,671	2,333,569	583,622	2,329,319	4,662,888
1877	135,933	2,274,639	504,031	2,384,378	4,659,017
1876	103,578	1,672,068	461,583	2,188,623	3,860,691
1875	111,992	1,924,544	526,015	2,774,419	4,698,963
1874	135,681	2,758,933	520,431	3,046,431	5,805,364
1873	102,293	2,667,386	473,291	3,631,996	6,299,382
1872	89,908	2,521,357	387,928	3,256,854	5,778,211
1871	49,071	1,009,508	286,697	1,600,651	2,610,159
1870	64,934	1,357,302	326,656	1,776,625	3,133,927
1869	63,699	1,444,968	328,154	2,020,519	3,465,487
1868	61,372	1,627,577	248,361	2,028,514	3,656,091
1867	30,264	980,699	187,098	1,984,865	2,965,564
1866	6,986	313,086	140,253	1,504,058	1,817,144
1860	81,440	1,916,289	431,565	1,818,238	3,734,527
1850	12,892	229,741	297,889	1,142,713	1,372,454
1840	3,246	63,348	145,475	602,529	665,877
1830	1,572	35,039	92,437	321,019	356,058
1820	887	17,748	3,938	17,583	35,331
1810	254	Not Given	4,190	Not Given	Not Given
1800	93	Not Given	1,722	Not Given	Not Given

MEMORANDUM:—The figures under rosin for years 1860 to 1882 except for 1866, include crude turpentine also. For the years 1830, 1840 and 1850, the figures under rosin include small quantities tar and pitch and crude turpentine.

The data given covers years ending June 30, from 1850 to 1889 inclusive. Prior to year 1850 for years ending September 30. After 1889 for years ending December 31. The government has at different periods used different statistical years.

EXPORTS OF NAVAL STORES FROM UNITED STATES TO SOUTH AMERICA FOR TEN YEARS ENDING JUNE 30, EXCEPT 1919, ENDING DECEMBER 31.

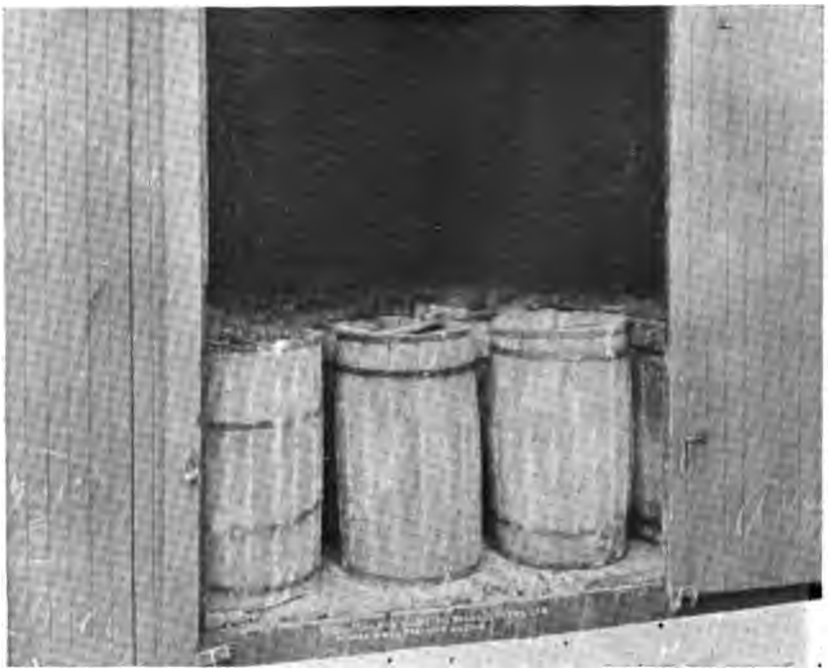
Spirits Turpentine in Barrels of 50 Gallons.

Country.	1909-10	1910-11	1911-12	1912-13	1913-14	1914-15	1915-16	1916-17	1917-18	Dec. 31 1919
Argentina	8,454	9,757	12,953	11,011	10,251	9,949	9,189	7,139	6,436	10,568
Bolivia	11	16	20	88	67	10	12	36	48	23
Brazil	5,112	5,728	6,685	7,133	6,038	6,264	6,032	6,022	4,447	6,156
Chili	2,176	2,717	3,885	2,620	1,689	1,633	3,159	2,091	4,825	930
Colombia	172	195	235	206	193	195	294	242	192	259
Ecuador	181	129	176	113	132	66	139	115	106	124
Guiana	47	46	43	33	48	49	53	65	70	54
Paraguay	....	19	62	78	71	....	....	2	77	2
Peru	560	694	1,192	851	700	443	820	1,184	900	589
Uruguay	973	1,222	1,282	1,171	961	1,220	1,246	714	992	1,658
Venezuela	229	269	282	262	240	223	338	345	349	443
Totals	17,915	20,792	26,815	23,566	20,390	20,052	21,273	17,955	18,442	20,806

Rosins in Barrels of 500 Lbs.

Country.	1909-10	1910-11	1911-12	1912-13	1913-14	1914-15	1915-16	1916-17	1917-18	Dec. 31 1919
Argentina	60,330	48,745	68,506	73,520	57,136	80,308	54,491	67,361	83,740	65,357
Bolivia	183	295	282	155	263	157	160	98	514	87
Brazil	82,318	97,335	99,100	101,193	54,688	59,096	74,225	82,579	88,912	86,527
Chili	3,999	3,790	3,373	6,391	2,654	1,618	3,430	6,854	7,222	5,800
Colombia	4,166	5,460	7,102	6,743	3,537	2,864	6,239	6,338	7,152	6,240
Ecuador	156	102	186	179	220	660	805	706	1,013	242
Guiana	125	176	58	40	38	67	123	186	50	116
Paraguay	431	....	468	526	....	....	....	41	....	11
Peru	2,818	3,923	3,723	4,635	1,945	880	1,536	3,078	3,330	1,014
Uruguay	16,859	18,143	16,951	19,639	10,630	13,546	12,879	13,573	12,903	13,387
Venezuela	4,552	4,035	4,790	4,733	3,832	3,051	3,408	3,917	2,705	3,962
Totals	175,937	182,004	204,539	217,754	134,943	162,247	157,296	184,761	207,571	182,743

NAVAL STORES EFFICIENCIES DURING WAR



A Car of Rosin Prior to the War

NO more striking commentary can be found on the efficiencies brought about by the necessities of war time than that afforded by a study of the methods employed in loading railroad cars with naval stores before and during the war and also a comparison of the quantities carried during the "piping time of peace" and the period of hostilities. In both instances one naturally wonders why such efficiencies should be restrained to times of warfare and the country denied them when the nation is engaged in the pursuits of trade and industry, and to what greater extent it might be possible to reduce the man power needed in loading and discharging and increase the carrying power of the railroads.

The four illustrations given herewith tell the story of this especial feature of the movement to make every ounce of energy, human and mechanical, tell during the eventful years of the war. As will be seen, prior to the war five men were required to load a car with one-half of the number of barrels of rosins that three men loaded into a car in the war time with less consumption of time and effort. They are interesting indications of what may be looked for when restraints are removed and the facilities of the country are permitted to be used to the fullest degree consistent with safety. That the old conditions should be returned to, or that they should be tolerated at any point where considerable freight is handled, seems incredible, yet no doubt the old labor-wasting methods are still in force throughout the country.

In this particular instance the improvements that liberated men needed for other work and transported much greater quantities per car were largely brought about by a special war service committee of which Mr. W. H. Crawford, of Cincinnati, was chairman. Turpentine and rosins entering into the manufacture of war materials, as well as in numerous industries of peace, their proper movement was necessary to expedite war measures as well as to keep the wheels of the consuming factories moving and prevent any greater dislocation of industrial life than could be avoided. The capacity of the common carriers was strained to the utmost in the movement of troops and essential war supplies. The car as well as the man shortage became increasingly acute and orders were brought about that no cars were to be furnished the producing territory for rosins unless loaded to their full capacity. At the same time consumers were likewise advised that their orders must be in sufficient quantity to insure maximum loading of cars. The results were speedily felt in a better movement of the commodity from the South and to all parts of the country. Steps followed to lift the embargoes on tanks of turpentine and to the issuance of orders to supply refrigerator cars to

Carrying Capacity Increased by War Time Efficiency Methods

Before the War, Five Men Required to Load a Car

naval stores people through the Southern turpentine belt when box cars were not available.

The withdrawal from industrial life of millions of hardy men made it exceedingly difficult to find adequate labor to load cars. Here mechanical ingenuity came to the aid of the trade in the Middle West where the inadequacy of labor was perhaps most keenly felt, and the loading equipment shown in the illustration was devised and satisfactorily used.

There was complete and effective cooperation between the producers, distributors and consumers of naval stores and the government during the war. Everywhere there was an eagerness to assist in every possible way in war measures. Naval stores men were found among the draft boards, among the four-minute speakers, among the committees that met with such wonderful success in selling bonds, in the relief committees, in fact in every phase of the varied patriotic and humanitarian activities brought about by the war. No industry, perhaps, suffered more than the naval stores industry did as a result of the war, but among no body of men was there a more signal demonstration of love of country and of the desire to be of service in every possible way. No opportunity passed to assist the government and to make the country's working forces a most effective unit for striking blows that would bring the war to an early close.

Actual Net Cash Returns.

FOR many years Mr. J. A. G. Carson, president of the Carson Naval Stores Company, has kept records of the actual net cash received by the naval stores producers selling their rosin and turpentine through his house. The statement is as follows:

Actual net proceeds to the producer per barrel of spirits of turpentine and per barrel of rosin (which includes all grades as received) handled by this corporation at the ports of Savannah and Jacksonville for our fiscal years commencing December 1, and ending November 30.

12 Months Ending Nov. 30.	Spts. Turp.	Rosin.	Per Unit One Cask Turpentine & 3 1-3 Bbls. Rosin
1907-8	$18.78	$ 5.22	$36.18
1908-9	20.68	5.84	40.15
1909-10	30.52	8.30	57.18
1910-11	28.20	10.47	63.10
1911-12	19.92	10.43	44.69
1912-13	17.00	7.00	40.33
1913-14	20.54	6.40	41.87
1914-15	19.05	5.69	38.01
1915-16	19.80	9.03	49.90
1916-17	20.20	9.47	51.77
1917-18	24.64	14.71	73.67
1918-19	54.60	25.68	140.17

The increase in the net proceeds per naval stores unit last season was nearly one hundred per cent. The expenses of production have increased enormously and while the producers found their operations quite profitable in 1919 the returns for the past three seasons show no excessive margin above expenses, in the opinion of experienced men. The industry, as is generally known, was on the verge of total collapse when the turn came in prices.

War Time Efficiency Loading a Car Saved Services of Two Men

THE PRINCIPAL USES OF ROSINS AND SPIRITS TURPENTINE

(Prepared by the Bureau of Chemistry, U. S. Department of Agriculture.)

PRINCIPAL USES OF TURPENTINE

VOLATILE thinner for paints, varnishes and wood fillers.

To accelerate oxidation of drying oils (as an ozonizer).

Solvent for waxes in shoe and leather polishes, floor polishes and furniture polishes.

Solvent for gums in lacquers and varnishes.

Ingredient of waterproof cements for leather, rubber, glass, metals, etc.

Solvent for waterproofing compositions.

Cleaner for removing paints and oils from fabrics.

Pharmaceutical purposes, including
- Disinfectants
- Liniments
- Medicated Soaps
- Internal Remedies
- Ointments

Raw material for producing synthetic camphor and indirectly
- Celluloid
- Explosives
- Fire Works
- Medicines.

Raw material for producing terpineol and eucalyptol.

Raw material for producing terpene-hydrate used in medicines.

Raw material for producing isoprene used in making synthetic rubber.

In the manufacture of sealing wax.

In glazing putty.

Ingredient of some printing inks.

In color-printing processes in lithography.

Lubricant in grinding and drilling glass.

As moth repellant and in moth exterminators.

Constituent of insecticides.

For cleaning firearms (alone or in combination with other materials).

In laundry glosses.

In washing preparations.

In rubber substitutes.

In wood stains.

In stove polishes.

In modeling waxes and grafting waxes.

In belting greases.

In drawing crayons.

In the manufacture of patent leathers.

As a substitute for pine oil in flotation concentration of ores.

Used to prevent "bleeding" in the manufacture of cotton and woolen print goods.

Laboratory reagent as substitute for more expensive organic solvents.

Oxygen carrier in refining petroleum illuminating oils.

Colored turpentine reagent for wood and cork in biological technic.

PRINCIPAL USES OF ROSIN.

Manufacture of rosin soaps including:
- Laundry soaps and soap powders.
- Sizing for paper and paper board.
- Paint dryers (resinates of lead manganese cobalt and other metals, Japan driers).
- Axle grease.
- Waterproofing compounds (insoluble rosin soaps).
- Emulsifiable oils (lubricants for high speed tool work).
- Leather dressings and shoe polishes.
- Enamels used in ceramics (resinates of heavy metals).

Manufacture of certain varnishes and lacquers.

Manufacture of plastic compositions, including:
- Filler in the manufacture of certain toys.
- Sealing waxes.
- Cores for foundry work.
- Rubber substitutes.
- Shoemakers' wax.
- Briquettes and fire kindlers.
- Artificial wood.
- Composition for pattern making.
- Papier-mache.
- Brewers' pitch.
- Roofing cement.
- Grafting wax for trees.
- Cheap linoleum and oil cloth.
- In shoe bottom fillers.
- Lutes.

Pharmaceutical purposes, including:
- Ointments.
- Plasters.
- Cerates.
- Internal remedies (veterinary).
- Disinfecting compounds.

Making roofing materials.

Adulteration of ceresin and paraffin waxes.

Adulteration of beeswax and making "artificial beeswax."

Adulteration of shellac and certain resins.

Manufacture of Venice turpentine substitute.

Flux for soldering and tin plating.

Dusting molds in foundries.

In dry batteries and electrical insulation (wiring).

Constituent of wood stains.

In belting grease.

On leather belts to prevent slipping (use inadvisable).

On violin bows.

For setting bristles in hair brushes.

Constituent of insect powders.

For the manufacture of "artificial copal."

In steel hardening.

Constituent of enamel for brick walls.

Coating for match splints.

Constituent for some floor waxes and polishes.

In wax tapers.

Hardening tallow candles.

In stamping powders.

Sizing for wood-pulp wall-board.

In pyrotechnics and in the manufacture of certain explosives.

Paper hangers' size.

In waterproofing compositions for paper cardboard and fabrics.

Manufacture of munitions (filling vacant spaces in shrapnel).

Making imitation Burgundy pitch.

Manufacture of sticky fly-paper.

Constituent of sweeping compounds.

Weather-proofing wooden fence posts.

In mixtures to protect trees from climbing insects.

Constituent of printing inks.

In cements (for glass etc.)

In the manufacture of condensation products used as substitute for amber, hard rubber, and other plastics.

As a raw material for producing certain chemicals (benzene derivatives).

In the manufacture of carborundum and calcium carbide (using sawdust and

refuse wood chips with residues from the manufacture of turpentine and rosin).

In sulphite-waste utilization. (Trippe process).

In Destructive Distillation to Produce:

Rosin oil and rosin oil products used in:

- Cements.
- Lubricants (oils and axle grease).
- Printing inks.
- Adulterating linseed oil.
- Belt oils.
- Brewers' oils.
- Insulating oils.
- Oil cloth and linoleum oils.
- Brewers' pitch.
- Varnishes.
- Rubber substitutes.
- Funnel paints for yachts.
- Flotation concentration of ores.
- Mixtures to protect trees from climbing insects.
- Shingle stains.
- Waterproofing textiles and cordage.
- Manufacture of lamp-black for lithographic purposes.

Soap making.

- Leather dressing and shoe polishes.
- Sweeping compounds.
- Adulterating olive oil and castor oil.

Rosin spirits used in:

- Illuminants.
- Turpentine substitutes.
- Cheap varnishes.
- Disinfectants.

Acetic acid used for making:

Acetate of lime (source of acetone).

Acetate of iron (mordant and mineral dye).

Acetate of alumina (waterproofing cloth).

Pitch used for:

- Some kinds of brewers' pitch.
- Cobblers' wax.
- Preserving cordage and nets.
- Roofing felts and waterproof papers and fabrics.
- Bituminous paints.
- Binder in briquettes.
- Caulking ships.
- Cements and lutes.
- Electrical insulations (dry batteries, wiring, etc.)
- Plastics for pattern making.
- Grafting wax for trees.
- Paving materials.
- Steel hardening compositions.
- Waterproof masonry.
- Brush manufacture.
- Pharmaceutical purposes.

"ONLY A SAPLING" BECAME FATHER TO A FOREST

(By H. E. Hardtner, Lumberman-Forester of Urania, La.)

IN 1902 a tract of long-lear pine timber was cut at Urania. A small sapling about 10 inches in diameter was left standing which with other suppressed trees commenced to grow rapidly. Year after year this tree bore seed which as they ripened were scattered by the winds and soon four or five acres were reforested with a fine growth of seedlings, some almost as large now as the parent tree at the time the forest was denuded.

An occasional fire would sweep over the forest, leaving a scar which would soon heal. Hogs exacted their toll and other enemies were constantly at work, but today there is a full stand of 500 to 1,000 seedlings and saplings to the acre and regeneration is complete.

In May, 1920, Professors Chapman and Bryant, with a class of thirteen students from Yale University, were at Urania pursuing a course of study in forestry and in studying tree growth decided to cut this seed tree, for that is just what it was, in order to make careful measurements and to cut sample sections therefrom to prove to the careless that forests could be grown profitably and that seed trees must be left on denuded lands if our forests are to be perpetuated.

"Only a sapling" was hauled to the mill and sawed into lumber and here is a table which gives actual facts and figures:

Age of tree in 1902, 114 years; in 1920, 132 years.

Diameter of tree at 4 1-2 feet outside bark, 10.4 inches in 1902; 18.2 inches in 1920.

Merchantable length in 1902, 48 feet; in 1920, 56 feet.

Merchantable cubic contents in 1902, 13 cu. feet; in 1920, 39 cu. feet; total increase on original volume, 200 per cent; annual increase, 11 per cent.

Scaled contents, Doyle rule, in 1902, 31 board feet; in 1920, 195 board feet; total increase on original volume, 529 per cent.; annual increase, 29 per cent.

Lumber mill tally in 1902, 100 board feet; in 1920, 326 board feet; total increase on original volume, 226 per cent.; annual increase, 12½ per cent.

Size of squared timber from butt log in 1902, 4x4 inches; in 1920, 10x10 inches.

Value of stumpage--In 1902 at $1 00 per 1,000; in 1920 at $10.00 per 1,000:

Doyle--Rule—In 1902, .03c; in 1920, $1.95; total increase on original volume, 6,400 per cent.; annual increase, 350 per cent.

Mill—Tally—In 1902, 10c; in 1920, $3.25; total increase on original volume, 3,160 per cent; annual increase, 175 per cent.

Value of sawed lumber:

Mill—Tally—In 1902, $1.70; in 1920, $15.48; total increase on original volume, 810 per cent.; annual increase, 45 per cent.

Seedlings in 1902, none; in 1920, 1,000 to acre.

TURPENTINING IN THE SOUTH ATLANTIC COUNTRY

(By Albert Pridgen)

[For forty years or more Mr. Albert Pridgen, now of the naval stores producing firm of Jackson & Pridgen, Metcalfe, Ga., has been actively identified with the industry. After some years' experience in the woods he became identified with the Savannah house of J. P. Williams & Co. as its traveling representative and for some years traversed the turpentine belt of Georgia and Alabama in that capacity. Later he engaged again in business as a naval stores operator in Georgia, subsequently removing to Louisiana, where he had charge of a large plant. He returned to Georgia several years ago and expects to remain a "turpentine man" until the final call comes.]

AFTER leasing or purchasing a body of virgin timber, the first step in the process of turpentining is the establishment of the necessary buildings to quarter the help, and the installment of stills, live stock, and other necessary equipments, which requires an investment of from $10,000 to $75,000, according to the size of the operation to be carried on.

The next step is to supply the place with labor skilled in this particular work, which requires an additional investment of from $1,000 to $10,000, according to the size of the operation. When this is done, the next thing is to prepare for the operation by installing the system which is to be used, either the box or cup system. The boxing or cupping is done in the winter months, between November 15 and March 1, while the sap is down. The box is a cavity, ranging in size from 10 to 14 inches in width, from five to seven inches in the stump, and from 2½ to 3½ inches in the back, according to size of the timber. The boxes are cut in the base of the tree, about 10 inches from the ground. Over the box, the chipping is done.

Where the cups are used, the tree is slightly hewn with a broadax, about 12 inches above the ground, and taking a space of about 12 to 16 inches wide, by scraping away the bark and a small amount of the wood, which makes a face, and an incision is made in the tree for inserting a gutter or apron, which catches the crude gum as it runs from the weekly streaks and conducts it into the cup which is fastened to the tree by a nail or wooden peg. The cup method, although more expensive than the old box method, is preferable both to the turpentine operator and the lumberman, for the reason that the incision required for the cup is only a slight one, and by no means damages the tree in the slightest degree where it is properly and judiciously operated. It also produces a better yield, in quantity, and higher grades of rosin.

Chipping or scarifying is cutting a space of wood up the tree at weekly intervals. The chipped area each week, known as a "streak," is about two-thirds of an inch in width, and about three-fourths to one inch deep in the tree. The chipping is done over the cup or box at an angle, from right to left and left to right, a length from six to eight inches on each side, according to the size of the tree, thus making what is called a "face." A face or scarified surface made during one entire season will run up the tree about 24 inches high, and from 10 to 16 inches wide, according to the size of the tree.

The chipping is done with a sharp steel instrument made for the purpose, called a "hack." The chipping or streaking commences about March 1, and continues each week for thirty-four consecutive weeks, which makes a full chipping season. The purpose of this fresh scarifying of the tree weekly is to stimulate the flowing of the gum.

The crude gum begins to run from the tree immediately after the chipping begins, and the dipping or gathering of the gum from boxes or cups begins three to four weeks behind the chipping, and is kept up through the entire chipping season at intervals of every three or four weeks. An instrument made out of steel, and called a "dip iron," is used to conduct the gum from the cup, or box, into a bucket, from which it is emptied into barrels and taken to the distillery.

The still is a large kettle made of copper, into which the gum is emptied. This kettle is connected by means of a "cap and arm" to a worm, which is also made of copper, and corresponds in size with the kettle. This "worm" is coiled about six and a half times in a large tank of water, and through it runs the steam and vapor rising from the boiling gum in the kettle. While in this "worm," the steam and vapor condense into water and spirits of turpentine, and empty into a tub attached to the lower end of the worm. The spirits being the lighter rise to the top, and the water recedes to the bottom of the tub. After this process, the spirits is drawn off into barrels, and is then ready for market.

A rosin barrel contains about 500 pounds gross, and all sales and purchases are made according to this understanding, but the calculation and price is based on a commercial barrel of 280 pounds.

A barrel or cask of spirits of turpentine is considered to approximate fifty gallons net, and carries with it the barrel or cask in which it is contained. Therefore, in speaking of both spirits and rosin by the term barrel, we mean a gross barrel of rosin and fifty gallons of turpentine.

When the process of distillation of the crude gum is completed, which takes from three and a half to five and a half hours, the fire is removed, and the contents of the still drawn off by means of a tap at the bottom of the still or copper kettle. This residue, or rosin, is allowed to run through a coarse wire cloth, then immediately strained again through brass wire cloth and cotton batting made for the purpose, into a trough, from which it is dipped out into barrels containing about 500 pounds. After congealing, it is graded, and ready for market.

Rosin is graded by different grades—"WW" the highest and "A" the lowest—designated as follows: W.W., W.G., N., M, K, I, H, G, F, E, D, C, B, A.

A, B, C, are now frequently classed simply as B rosin, making twelve quoted grades.

The highest grades of rosin are made from virgin boxes or cups, utilizing timber hitherto unbled, during the first months of the first year's operation, from April to July. As the season progresses, the scarified or chipped face above the box is gradually raised by the succession of weekly streaks, and being exposed to the air and sun causes a gradual accumulation of lightwood, or a fatted face, which contains a certain amount of colored matter, that seeps into the crude gum and colors the rosin, and lowers the grade. The product of the second year's operation under the box system runs still lower in grade, by virtue of having more face for the exuding gum to pass over to reach the box, and more accumulation of this matter to darken its color. The third year brings still more face and more accumulation of colored matter, and the lowest grades of rosin are the result. The more recent method of using the cup system partially removes this difficulty, as the cup is moved up every year above the old face, thus escaping the colored matter in these faces, and therefore there is a larger percentage of higher grade rosin made now than in former years, and less of the lower grades. The rapid extension of the cup system will accentuate this condition, and likewise conserve the timber.

At the close of the chipping season, there is an accumulation of crude turpentine on the face of the tree, which

DIPPING THE GUM FROM THE BOX

has been exposed to the sun, air, and rain, and hardened on the face, which is called scrape. This contains approximately one-half as much spirits of turpentine as the crude dip from the boxes or cups, and about twice as much rosin. The gathering of the scrape crop begins in the early fall, and continues through the winter. The late receipts of naval stores come from the "scrape."

A crop of boxes or cups is 10,500, and all contracts pertaining to a crop are based on this number.

It generally requires about two hundred acres of pine timber for a crop of cups or boxes, though if the timber is thick and large it will take much less, while if the timber is small and scattering it requires much more.

A crop of boxes, if in large rich timber, will produce about fifty barrels of spirits of turpentine the first year it is operated, and about one hundred and sixty gross barrels of rosin. The same crop will make the second year about forty barrels of spirits of turpentine, and about one hundred and thirty-five barrels of rosin. The third year it will make about thirty barrels spirits of turpentine and one hundred and fifteen barrels of rosin. The total production from a crop of large timber in three years approximates one hundred and twenty casks spirits and four hundred and ten barrels of rosin.

The yield from the cups on the same timber will be about fourteen per cent. more. This yield applies to the best timber in Western Mississippi, Louisiana and East Texas, which makes an average yield of about forty barrels per crop, where the first, second and third year classes of boxes are operated together. Figuring on the same class of boxes for Georgia and Alabama, the average annual yield would be about thirty-five barrels per crop in those States; and in Florida about twenty-six barrels.

If the operation is continued on the timber for the fourth and fifth year, the yield is reduced in about the same proportion mentioned above. The turpentine privilege on timber is frequently leased for three, four, or five years.

The cost of producing turpentine now is much more than ever before, and the time when it was possible to produce cheap turpentine is past. The price of lands, material, and labor required to make turpentine has gradually increased for the past twenty-five years, until it now reaches a total cost of at least four times as much as it did twenty to thirty years ago. Prices of land in those earlier days ranged from fifty cents to three dollars per acre, in fee simple; the same lands now range in price from ten to one hundred dollars per acre.

Turpentine leases on the same land could then be procured for from twenty-five to seventy-five cents per acre for a term of three years, or an average cost of about seventy-five dollars to one hundred dollars per crop. The same timber now costs from $1,000 to $2,000, or an average of $1,500 per crop. Other necessary materials and supplies for the manufacture of naval stores in those days were much less than they are now. For instance, feed stuff and provisions are at least 200 to 300 per cent. more than twenty-five years ago. Careful estimates show that the total cost of production today is approximately four to five hundred per cent. greater than a quarter century ago.

A turpentine operator twenty to thirty years ago could go into the States of North and South Carolina, and within from three to five days get all the necessary labor he wanted to operate his business for twelve months, brought to his farm, at a cost of from fifteen dollars to twenty-five dollars per head. Now it costs, in accounts that have to be paid, recruiting expenses, and transportation, probably two hundred dollars per head for each head of family he brings in, and sometimes in addition to this a lawsuit and a heavy court fine for violation of a "Labor Law."

The enactment of labor laws by the turpentine producing States of the

A Typical Georgia Turpentine Still

South during the last twenty-five years has made the expense of the necessary recruiting and transporting of labor from State to State cost nearly as much now as the average turpentine laborer received for his wages twenty to thirty years ago. These laws, while they were intended to serve an honest purpose in protecting the landlord in the necessary advances made to labor, have brought a curse upon both.

The landlord, feeling that he is somewhat protected under these laws, makes more liberal advances than he otherwise would, resulting in the accumulation of a big debt, which the negro can never work out, but is held against him to keep some other man from moving him away, until these accounts are sometimes paid by turpentine operators, which adds largely to the cost of making turpentine. The labor problem in the industry promises to become more acute from year to year.

One phase of this subject which for some reason is rarely touched upon, is the home life of the turpentine producer. When he and his accompanying forces make their way into new territory he finds himself a pioneer in the vast stretches of pine forests, and has therefore to undergo all the hardships and privations which his position incurs.

The pioneer citizens of fifty years ago who moved into the West with their families and household goods in a prairie schooner did not find conditions more raw and difficult than the modern turpentine producer who moves into a new territory. His connection with the outside world is almost severed.

By virtue of necessity, his mode of living is primitive, his home merely a shelter from the elements, and modern comforts and conveniences become as dim as a mythological story of another planet. His daily menu consists of cornbread, bacon, black coffee, and an occasional treat of baking powder biscuits.

Instead of the society to which in days past he has been accustomed, he is forced into daily contact with the hired labor and negroes of his constituency. Should he be a man of a family, he is dispossessed of school advantages for his children, and is forced either to employ private teachers or send his children perhaps hundreds of miles away to school. Church privileges, too, are almost unknown to him, and by virtue of his environments he loses that veneer of refinement which accrues from association with his own kind.

In addition to all this, the lawlessness which characterizes the majority of negro labor makes the life of the operator one of danger. A certain inherent recklessness, together with the effects of drinking bad whiskey, or a substitute called "Buck," combine to make a state of lawlessness which it requires constant surveillance on the part of the operator to suppress. Remotely situated as he is, away from officers of the law, he is forced to fill that position for himself, and quell disturbances and settle difficulties at the risk of his life. He must be prepared to meet emergencies of any character on a second's notice.

By reference to the danger a turpentine operator is subjected to, I do not mean that a turpentine negro is any worse than others of his race under similar conditions. The country at large has somehow gotten the idea that the turpentine negro is worse than other kinds of negroes. This impression is an erroneous one, and one which, in justice to the turpentine negro, should be corrected.

Anyone who has dealt with the negro to any extent knows that where a large number of negroes are collected, there is, and always will be, an element of lawlessness, which it takes the constant supervision of the white man to keep in check. This element, however, does not show itself more conspicuously in the turpentine camps than in saw mill quarters and on large farms. But at the same time there is no gainsaying that the turpentine camp is no place for a man who is timid or cowardly, or averse to being prepared to use force or weapons in self-defense.

Negro Hand Cutting a Box

BRUNSWICK AS A NAVAL STORES PORT AND MARKET

(By C. Downing.)

[For thirty-five years Brunswick has been an important naval stores port. In 1893 it displaced Charleston for third place and in 1895 disp aced Wilmington for second place, retaining that position for probably fifteen years, falling behind Pensacola for a few years and now exceeding that port in its receipts. For some years over 300,000 barrels of naval stores were handled at Brunswick. The development of the port in this connection was mainly the result of the efforts of Mr. C. Downing, president of the Downing Company, one of the leading factors in the industry for the past three decades.]

BRUNSWICK was first discovered as a suitable port for handling naval stores by Mr. Jno. D. Sprunt of Wilmington, N. C., in the year 1876. Mr. Sprunt was the pioneer naval stores factor at Brunswick, and conducted a small business here for three years when he was succeeded by Mr. A. V. Wood, also of Wilmington, in 1879. Mr. Wood was succeded in 1883 by Downing, Buck & Company, which firm was followed by The Downing Company in 1890. From 1890 until now the Brunswick market has always been a favorite among turpentine producers.

The Downing Company is the only factorage house at Brunswick. It has become a trade axiom that once a turpentine man becomes a customer of The Downing Company he never changes his business, but is a fixture for life, or as long as he continues in the naval stores business.

In the seventies Brunswick's receipts of turpentine were only about 5,000 casks, with about 16,000 barrels of rosin per year, but from 1885 the business increased in volume until 1901, when receipts were 73,000 barrels turpentine and 255,000 barrels rosin. For several years Brunswick ranked second in receipts,—Savannah holding first place, but now Jacksonville has taken first place, Savannah is second and Brunswick third. Brunswick's receipts for the past nine years have averaged about 45,000 turpentine and 140,000 barrels of rosin annually.

A large portion of Brunswick's receipts are exported direct to Europe and the Continent, and to handle this business Brunswick has exceptional advantages. It has ample yards and warehouses and tank facilities for the storage of twice as many barrels of

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SCENE IN THE BRUNSWICK ROSIN YARD

JACKSONVILLE AS A NAVAL STORES PORT AND MARKET

(By George H. Baldwin)

[Mr. George H. Baldwin, formerly of Savannah, became assistant to the president of the Commodore Point Terminal Company in April, 1919, and on February 1, 1920, was made vice-president and general manager of the company, in charge of all of its operations, including the naval stores yard, the largest and most modern storage and handling yard in the world, through which pass all of the receipts of Jacksonville, which for several years has been the largest primary market for naval stores, and has been an increasingly important distributing point for domestic and foreign trade. Every exporting house either has an office of its own at Jacksonville or representation through a broker, of whom there are several established there, and the factorage interests are represented by largely capitalized and experienced houses. Indications are that Jacksonville will play a more important part in the foreign trade in the future and that with the greater care that will be taken of the Florida pine forests hereafter it will retain its supremacy as to receipts for many years. For the past seven years the receipts at the port have been as follows: 1913-14, 113,145 casks spirits turpentine, 353,688 barrels rosin; 1914-15, 106,070 spirits turpentine, 306,690 rosin; 1915-16, 110,853 spirits turpentine, 441,278 rosin; 1916-17, 148,119 spirits turpentine, 506,389 rosin; 1917-18, 132,870 spirits turpentine, 457,236 rosin; 1918-19, 76,175 spirits turpentine, 270,387 rosin; 1919-20, 89,748 spirits turpentine, 332,128 rosin.

General View of Jacksonville Naval Stores Yards at Commodores Point Terminals, showing Turpentine Warehouse, Turpentine Tanks and Rosin Yard

THE port of Jacksonville, Florida, has grown in the past few years from a position of not very great importance in the naval stores industry to one of first importance. As the pine forests of the Carolinas and Georgia became gradually worked out, Florida took its present place as the greatest producer of naval stores, and the South Atlantic State with the only future possibilities for naval stores production.

This change in the producing territory naturally called for facilities in the city of Jacksonville, both financial and physical, for handling Florida's naval stores. This led to the establishment of local factorage houses, which have grown to positions of the largest importance in the industry, and to the establishment in Jacksonville of branches of most of the houses whose headquarters are in Savannah.

At the present time there are in Jacksonville the headquarters of seven naval stores factorage houses and branch offices of two other factorage houses. This development has meant that Jacksonville has grown to be, and has for some years been, the largest handling and distributing center for supplies for naval stores producers.

Following the factorage houses, soon came buyers and exporters of naval stores until today all the large houses of this kind have branches or agencies in Jacksonville and do a large export business direct from this port, particularly to South America and Japan.

There are also three large plants refining rosin from dross and other waste, an extensive wood products plant, and manufacturers of turpentine stills, cups, etc.

The harbor of Jacksonville up to about three years ago was not suitable for vessels of any considerable draught, but at the present time the Government has practically completed a thirty-foot depth channel making it possible for large merchant vessels to enter this port for cargo, and this fact has been taken advantage of by local and other shipping companies to build up a large and fast increasing export tonnage.

The naval stores storage yard originally located in Jacksonville was placed without regard for export movement and was purely a domestic storage yard. The same company, however, operated an export storage yard and dock at Fernandina, Florida, where the exporters of Jacksonville handled practically all of their export movements from this territory.

With the increase of the foreign trade of Jacksonville and the number of boats calling here, the necessity of a waterfront yard was seen, and the old Jacksonville and Fernandina yards were finally sold to the Commodores Point Terminal Company, which constructed on the Jacksonville waterfront a modern storage yard. This company is now operating the largest single naval stores yard in the world, with storage space for 200,000 barrels of rosin, tankage capacity for 30,000

Naval Stores Yard at Commodores Point Terminals, Jacksonville, showing Warehouse and the Concrete Bulkhead Construction on River Front

barrels of turpentine, and covered storage space for 12,000 barrels of turpentine in wood.

This yard is equipped in every way with the most modern appliances for handling all the various operations connected with the receipt, storage and shipment of naval stores, and itself performs all of these operations with the exception, of course, of the inspection, which is done by State Inspectors.

In this way the entire former naval stores storage and shipping business of Jacksonville and Fernandina has now been concentrated in one yard on the water front of Jacksonvi le, and during the past year vessels have loaded here for various parts of the world, including several for Japan and an average of about one per month for South America.

The fact that the entire storage business in Jacksonville is done by one company on a single yard is one of the great advantages of Jacksonville as a naval stores market, for here the entire stock is all in one locality and no time is lost in concentrating stocks for shipment from two or three yards.

Jacksonville is particularly well suited as a naval stores port due to the large movement of phosphate rock and to the growing quantities of lumber and general cargo moving through the port for export.

During the season ending April 1st, 1920, 332,128 barrels of rosin and 89,748 casks of turpentine were handled through Jacksonville.

The Jacksonville Chamber of Commerce has been a potent factor in promoting the naval stores interests of the port.

All of the factors, dealers and brokers are members of the organization and constitute an enterprising and thoroughly alert naval stores section.

The daily market is held at 3:00 p. m. when the bids are received, opened, considered and the quotations established and posted. Jacksonville's quotations are now published in the leading newspapers of the country and its status as a market is firmly established, commanding the attention of dealers and consumers everywhere.

Loading Rosin for Foreign Shipment at the Jacksonville Naval Stores Yard

BRUNSWICK AS A NAVAL STORES PORT AND MARKET

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naval stores as are now marketed here. With plenty of water at The Downing Co. wharf, vessels can load to twenty-seven feet and go to sea on one tide.

Brunswick rosin is known all over the world and as the trade well knows is frequently called for by foreign consumers.

Brunswick has the largest and most complete plant yet built for the manufacture of rosin and turpentine from pine stumps and lightwood, in the Yaryan Rosin & Turpentine Co., which has a capacity for producing 350 barrels rosin and 100 barrels turpentine daily.

The Good Lord evidently created Brunswick for a great distributing point. F. D. Carley, of Standard Oil Co., on his first visit to this city, thirty-nine years ago, made the discovery and called the attention of the heads of that great organization to Brunswick, but the High Command turned a deaf ear to Carley. Thirty-eight years later the Standard investigated and were convinced, and today one of the largest and best and most up to date oil refineries of Standard Oil Co. is located at Brunswick. Mr. Carley's judgment has been vindicated after nearly forty years.

As to the future, it is thought Brunswick will maintain her position in the naval stores world as long as there are any pine trees left, and if the owners of timber use any sort of care the industry will continue indefinitely.

THE NAVAL STORES INDUSTRY IN THE WESTERN TERRITORY

(By Carl F. Speh, Secretary Turpentine & Rosin Producers Association.)

[Mr. Carl F. Speh was connected with the Forest Service, U. S. Department of Agriculture, 1907 and 1908, at which time he went to the Bureau of Chemistry, where he stayed until 1917. His work in the Department covered the range of wood preservation, tanning material, paper work, wood distillation and naval stores. The last three or four years were spent in the field of both producing and consuming territory. It has always been his ideal to be as well informed on the naval stores industry, both producing and consuming, as any one in the business. In 1917 he resigned from the Bureau of Chemistry at Washington to become Secretary and Manager of the Turpentine & Rosin Producers Association, with headquarters at New Orleans, La., which Association was fostered and formed by a few of the larger independent producers. The Association aims to work for the entire industry's welfare—such work as can be legitimately done which will reflect in benefit to the producers or the industry, whether located in Texas or Georgia. Mr. Speh's unselfish interest and ability are recognized by all.]

THE NAVAL STORES INDUSTRY must take its place with many of the other industries of this country which have in their early days squandered and destroyed without regard for the future their raw material; in our case,—the pine tree. Unquestionably, it was through dire necessity that the first producer ventured into the Western territory. His destructive methods and the saw mills which followed him blasted the country which had up to that time provided him with trees from which to produce turpentine and rosin. From all the information available to the producers of those days, pines in Western Mississippi, Louisiana, and Texas were unsuited for turpentine and it must have been with considerable hesitation that they consented to leave the Carolinas and Georgia on what they considered to be a foolish and useless experiment.

Experience, however, soon showed that the pines in the Western Territory were of the same character as those to which they were accustomed in the Atlantic States. We find this pine belt runs across Alabama a few miles south of Montgomery, with a few irregular patches in the more hilly country around Birmingham as far north as 34 degrees, 30 minutes North latitude, continuing across Mississippi at about Meridian, but ceasing abruptly before it completely crosses to the Mississippi river, meeting there the alluvial deposits of the Mississippi. We find none south of New Orleans. Towards the west we find none as we cross the sugar-cane and rice belts until we get about two-thirds across Louisiana, at which point it starts again going as far west as Eastern Texas, where it becomes a very narrow strip extending as far north as 32 degrees latitude. In Louisiana and Mississippi it extends not more than a half degree further north. In the extreme southern part of Louisiana and Texas we find none.

Vast as this territory, combined with the Atlantic coast states is, the yellow pine is rapidly disappearing, and in view of this fact the Forest Service in 1911 conducted experiments on the Western yellow pine in Arizona and California with a view of determining their possibility as a source of naval stores. The operator today probably looks upon these western pines in the same way in which the Georgia operator looked upon the Louisiana and Texas pines back in 1890.

Unfortunately, where there are records, they are so incomplete and vague as to be practically useless as a source of information in connection with the history of the industry. According to the best information available, J. C. Orrell was probably the first operator in

General View of Woods. Each Tree is Worked According to Specifications Laid Down by Timber Owners, Limiting Size and Number of Faces and Depth and Size of Wound.

Chipping, i. e., Wounding or Scarifying the Tree to Cause a Flow of Gum. The Paddle Against the Tree is to Keep Chips Out of the Cups.

Collecting the Crude Gum from the Cups After It Has Dripped from the Tree Into the Receptacles.

Mississippi, operating in Jackson county in about 1850. Later, in about 1895, the Locke-Moore Lumber Company opened a place at West Lake, La., shipping their product to A. Vizard, at New Orleans, shutting down very shortly because of low prices. In 1897 Dr. Jones opened a place, becoming a customer of A. Vizard.

Very closely allied to the history of the producing industry is that of the growth of the A. Vizard Company, which acted as commission merchants for naval stores. Alex. McDonald, of Cincinnati, entered into an agreement with A. Vizard and acted as their agent in Cincinnati, where we find rosin being shipped in 1860. In 1870 Emanuel Blessy started as dealer in New Orleans followed very shortly by John F. Simpson, of Simpson & Tricou. In the 90's combination was brought about by Simpson & Vizard. At that time we find about four or five places in Mississippi and one in Alabama shipping to New Orleans for distribution. About 30,000 barrels of turpentine were handled, representing practically the entire output of the Western territory. In 1895 A. Vizard bought out Simpson and in 1901 started the first exporting distribution, although a reference is made to a foreign shipment being made about 1859 of 210 barrels from New Orleans. At that time the factorage money was about 8% and they operated on about 2½% commission.

There was considerable speculation in timber and many thousands of acres changed hands at 50c and 75c an acre. It was about this time that W. B. Gillican became interested in Mississippi, and about 1900 opened up places in the neighborhood of Bay St. Louis and what is now Pass Christian. Located in the same territory and influenced through the results obtained on the operations of W. B. Gillican, we find places opened up by J. J. Hurley, at Fenton, Miss., running as the Bay Manufacturing Company, and shipping in to the Bay Naval Stores Company at New Orleans. Places were opened at Vidalia, Miss., H. E. Smith Company, at Catahouls, J. H. Long Company, Dixie Turpentine Company (F. Paine), Jordan River Turpentine Company, (McLeod), Dill & Vizard, at Dillville, Standard Turpentine Company, Ruben Brown. Probably the furtherest north

was Zach Lee, at Carriere, Miss. Probably the largest place at that time was the Center Turpentine Company, at Caesar, Miss., operating 50 crops and run by R. R. Perkins.

In the late 90's S. P. Shotter started the firm of Moses & Company, in New Orleans and Mobile. Shortly after there developed as an outgrowth the New Orleans Naval Stores Company, which was mainly a consolidation of the places in Southern Mississippi. We soon find the birth of the American Naval Stores Company, which handled practically the entire output of the Western territory. In April, 1903, the A. Vizard Company, who were up to that time the largest handlers of naval stores, sold to Shotter. From now on the history is very closely allied to the history of Savannah and Jacksonville.

The lumber companies looked upon the naval stores industry as more or less of an experiment, to say nothing of a nuisance. Timber was reluctantly leased to the operator, probably the majority of the production coming from fee simple owned timber of the producer. Gradually, however, their interest was aroused and after being convinced that the bleeding as conducted by the cup system caused little or no damage, leases were made more willingly. It was but one step to deciding to operate their own timber and today we find the Kaul Lumber Company, Algier Sullivan Lumber Company, Atmore Lumber Company, W. T. Smith Lumber Company, J. J. Newman Lumber Company, Edw. Hines Lumber Company, Dantzler Lumber Company, Fernwood Lumber Co., McInnis Lumber Co., Finkbine Lumber Co., Poitevent & Favre Lumber Company, G.eat Southern Lumber Company, Gulf Lumber Company, Industrial Lumber Company, Bowman Hicks Lumber Company, Brooks Scanlon Company, Lutcher Moore Lumber Company, each operating a naval stores department.

It is probably a well recognized fact that the average yield per crop in the Western Territory is greater than the average yield per crop in Florida, Georgia and certain sections in Alabama. This is due to the greater number of large trees in the crop in the Western Territory as compared to the average crop in the Eastern Territory. There are, however, many places in Florida and I do not doubt quite a few in

Using Shove Down to Get Off Scrape, Taking As Little Wood As Possible. The Scrape is the Gum Left on the Tree Due to the Evaporation of the Spirits. It is Gathered in the Late Fall and Winter.

Squad Raising Cups at the End of First Year's Operations. This Removes the Necessity of Crude Gum Flowing Over the Length of the Entire Face to Reach Cup.

Older Faces on Trees, Showing Jump Streaks. After the cup has been raised it is sometimes considered desirable in mid-season to prevent the gum flowing over the entire length of the face. To again raise the cup at that time would be too costly as well as involving too much labor. The same end is accomplished by skipping about one to one and a quarter inches of wood and putting on a new streak about that distance above the shoulder with its peak the same distance above the old peak. In other words a streak is jumped. This serves the purpose of furnishing a ledge from which the gum drops to the cup. The practice has many supporters who claim an increased yield of spirits and paler grades of rosin. Its opponents claim loss of gum by being blown away and the disadvantage of going up the tree that much higher.

Raking the Woods At End of Operating Season. In Order to Protect the Timber and the Cups and Faces of the Trees the Woods Are Burned Under Careful Supervision. All Trash Is Raked from Around the Trees to Protect Them.

Georgia which are capable of producing a yield per crop equivalent and probably better than the average yield per crop in the Western section. (See footnote.)

There are plenty of trees which will run 16 inches diameter breast height, and stories are told of faces which are over 30 inches in width. The timber is operated in practically every case on very stringent specifications. This works a benefit both ways; both to the timber owner by not retarding the growth of immature timber and by prohibiting the operator from operating this timber which will decrease the profit from his general operations.

The average grades produced will probably be the three tops, although there are several places which produce nothing under "WW" until late in the fall. In fact, "WW" in this territory is made from scrape and can be done in other sections if the same care will be given.

Without appearing to boast, the Western Territory has led the naval stores industry in efficiency of production. This is probably due to the better character of timber and unquestionably also due to the fact that higher cost of operation compelled the producer to make every possible effort to increase his revenue, either by increased production or by better grades. The reluctance on the part of the timber owners by the saw mills to permit their timber to be turpentined compelled the operator to accept and later offer severe restrictions in the working of timber. It was only by these means that many of the timber owners could be persuaded to permit their timber to be operated. Therefore, instead of the timber being worked five, six or eight years, we find that about 1900 the practice became prevalent of limiting operation to three or four years. Since then, because the saw mills were following the naval stores operations so closely, it became necessary to limit the operations to two or three years. This is an

The United States Census Bureau in 1909 made the following report as to the average yield of turpentine in the several States per crop of 10,500 boxes in barrels of 50 gallons: Alabama, 35.6; Florida, 29.8; Georgia, 26.5; Louisiana, 44.7; Mississippi, 34.5; Texas, 43.5. As regards the average yield per crop credited to Louisiana and Texas, the explanation was given that the timber worked there was much larger than the timber then being bled in other States.

added reason for the preponderance of pale grades of rosin and the better yield per crop of spirits. Very careful consideration is shown the timber and the operator is restricted to the size tree to be worked, the number of cups permitted to any size tree, distance from the ground to start, depth of chipping rate of going up the tree and the number of years to be worked.

Table below will show the production in this territory:

TURPENTINE PRODUCTION—IN BARRELS (50 Gallons)

	1905-06	1907-08	1908-09	1909-10	1910-11	1911-12	1914	1917	1918
Alabama	62,162	71,000	74,500	57,000	47,000	54,000	54,435	57,119	33,076
Louisiana	....	....	....	24,625	....	....	45,042	67,321	52,636
Texas	....	....	....	4,415	....	....	12,943	31,902	23,086
Mississippi	63,207	45,000	45,000	32,000	35,000	40,000	47,701	47,082	31,217

ROSIN PRODUCTION—IN BARRELS (500 Pounds)

	1905-06	1907-08	1908-09	1909-10	1910-11	1911-12	1914	1917	1918
Alabama	360,469	418,000	447,000	310,000	310,000	356,000	294,820	343,033	193,253
Louisiana	30,023	....	....	139,486	....	....	269,274	411,118	285,939
Texas	....	....	....	27,777	....	....	74,355	196,493	124,295
Mississippi	362,835	255,000	278,000	193,000	212,000	244,000	275,205	274,636	169,555

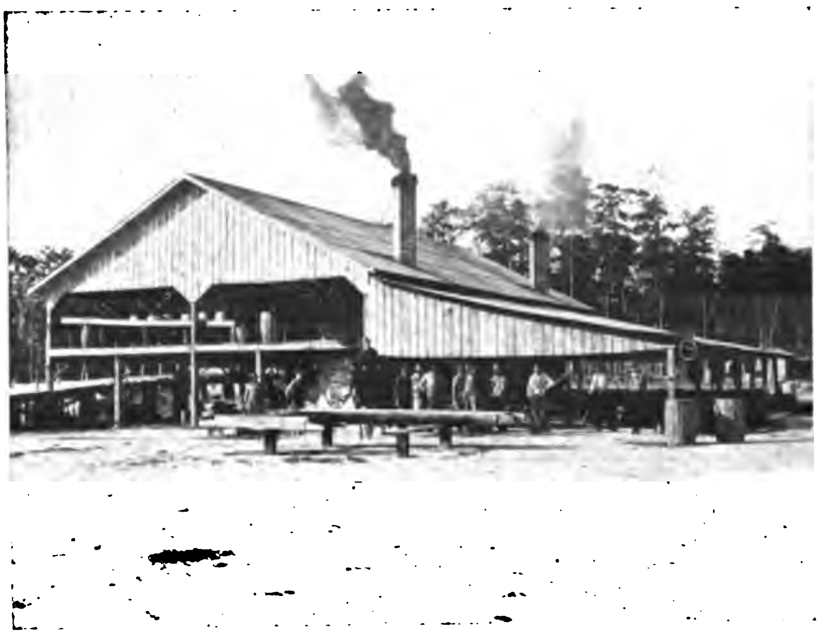
Growing from practically nothing in the 90's to what we now find, the Western Territory can be justly proud of its development in thirty years. The industry has benefited by the increased shipping facilities of the many Gulf Ports. Below is given table showing exports from New Orleans:

	Turpentine	Rosin
1890-1891	9,198	58,768
1891-1892	10,004	55,568
1892-1893	12,888	72,081
1893-1894	15,816	78,956
1894-1895	13,123	56,772
1895-1896	12,160	56,348
1896-1897	15,018	67,598
1897-1898	16,605	69,049
1898-1899	17,290	68,772
1899-1900	20,954	91,255
1900-1901	19,268	83,588
1901-1902	21,938	94,336
1902-1903	33,103	108,003
1903-1904	36,017	133,126
1913-1914	16,782	161,975
1914-1915	14,098	120,132
1915-1916	10,508	120,958
1917-1918	1,038	30,852
1918-1919	16,858	106,370
1919-1920	45,313	275,117

Conditions have necessitated the establishment of branch offices of most of the exporting houses, and we have in New Orleans representatives of the Columbia Naval Stores Company, London-Savannah Naval Stores Co., Rosin & Turpentine Export Company; in addition we have the head offices of the Gulf Naval Stores Supply Co., Turner Commercial Company, John P. Rausch Company, Chas. Robinson, and A. Hardaker. Up to several years ago D. D. Peabody had a sales organization, D. D. Peabody handling the output of a majority of the independent producers. There are also well known manufacturers of turpentine stills, cups, and other supplies in this territory, and wood products plants.

The Gillican-Chipley Company has risen from a small organization with its foundation back in 1900 to the largest producing interest of naval stores in the world, with operating places in Texas, Louisiana, Mississippi, Alabama, Florida and Georgia. Their immense operations have compelled them to build up a wonderful selling organization and in addition to the above distributing companies, we have in New Orleans the head office of the Gillican-Chipley Company.

The Old Reliable Mule Teams for Transportation. Loading Barrels of Scrape in the Woods to Haul to Still. Auto Trucks Also Are Used for This Purpose.



General View of Still Shed, Showing Deck, Rosin Vats, Strainers, Dip Buckets, Etc.

Unloading Platform at the Still Shed.

It is far from an idle dream to prophecy the establishment of distributing centers for increased export trade in New Orleans. In fact, we are today seeing many indications of this. In addition to the storage yards on the east side of the Mississippi River,—Crescent City Storage & Warehouse Company, London-Savannah Company, John P. Rausch, and the yards of A. Hardaker on the west bank of the river, there have been erected two of the largest turpentine storage tanks in the country. This place has modern facilities for barreling, and putting up case goods and as soon as conditions warrant and permit, equipment for handling rosin will be installed. Loading will be done direct to steamer or lighter as the case demands.

The Western Territory can also claim three factorage houses, Taylor-Lowenstein, Alabama Naval Stores Co., at Mobile and Jennings Naval Stores Company, at New Orleans.

What the future holds for us is hard to tell. The saw mills are rapidly depleting the timber and in all probability we have seen the peak of production. Attention is already being turned to Georgia and Florida for its second growth. There is developing, however, very strong sentiment in favor of affording every possible protection to the young timber with a view of providing a second crop. Maybe the drift will soon turn eastward.

The photographs from which the illustrations for this article were made were kindly supplied by The Gillican-Chipley Company of New Orleans.

THE NAMES OF ROSIN GRADES

NOT many people outside of the naval stores market who read the alphabetical quotations know that each grade, with two exceptions, has long since received a baptism, and been dubbed with some good name, embracing both the masculine and the feminine genders.

The only grades that have escaped the christening are the two tops, which are known as Waterwhite and Windowglass, generally referred to as W.W. and W.G., their names indicative of their transparency.

The other grades have been given names in years long gone by, the initials of which correspond to the official titles of the grades. They are as follows:

Grade.	Names.
N	Nancy
M	Mary
K	Kate
I	Isaac
H	Henry
G	George
F	Frank
E	Edward
D	Dollie
B	Betsey

In the past, before A, B, and C grades were grouped as B, C was dubbed Carrie and A received the gentle name of Alice.

These names serve as a convenience in telephoning, saving the confusion frequently resulting from the use of merely a single letter.

MANUFACTURE OF CAMPHOR FROM SPIRITS TURPENTINE

At various times synthetic camphor has been made from turpentine. Several processes, more or less alike, have been utilized, with good results, it is stated, but the commercial results have not been such as to induce any extensive operations. In this country two or three plants were engaged at one time or another in this industry, but it is probable that nowhere today is turpentine utilized for this purpose. Some years ago the following was published as descriptive of one successful process:

"Spirits of camphor are converted into the solid form (to be used as a substitute for camphor for various industrial purposes, and especially in the manufacture of celluloid) by rectifying commercial turps by distillation over caustic soda, and then exposing it to the action of dry hydrochloric acid gas, the monohydrochloride of turpentine being thereby produced. This body is freed from accompanying liquid monohydrochloride, then washed several times in cold water, dried, and placed in an autoclave capable of resisting a pressure of six atmospheres. Here it is treated with 50 per cent. of its own weight of caustic soda mixed to a thick paste with an equal weight of alcohol, and the whole is heated for several hours at about 140 deg. to 150 deg. C.

"The next stage consists in washing the mass several times, to eliminate the mixed common salt and caustic soda, after which the product (camphene) is treated in the following manner: The camphene is placed in a special autoclave, along with water strongly acidified with sulphuric acid, the whole being then heated until a pressure of 42½ pounds per square inch is attained. At this stage an electric current, of sufficient strength to decompose the water, is passed through the mixture, the latter being meanwhile kept in continual agitation, either by mechanical stirrer or a small steam jet. After a little more than an hour the mass is taken out of the apparatus, washed, dried, and sublimed if necessary, and is then fit to replace camphor for industrial purposes, the camphene being now converted into camphor, either the dextro-rotatory or inactive variety, according to the origin of the turps employed. In the electrolytic process just described, acidified water may be replaced by substances like hydrogen, peroxide, barium peroxide, permanganates, etc., capable of yielding up oxygen, under the influence of the electric current."

Deck Floor at Still Showing Cap and Neck of Still of the Separate Charging Opening Type. Barrels Full of Scrape Ready for Stilling.

Rosin Straining Vats—Rosins Strained Through Three Strainers, No. 4, No. 40 and Cotton Batting.

Copal and Kauri Gum Are Merely Fossil Resins

(By V. E. Girotlisch,

Leather and Paper Laboratory, Bureau of Chemistry, Washington, D. C.)

COPAL and kauri gum or resin, are the names of certain hard or fossil resins used in varnish manufacture. Commercially, the term "copal" usually means any hard or fossil resin used in the manufacture of oil varnishes, and which must be melted in order to be soluble in the linseed oil. The various copals are known by the name of the district in which they are found or the port from which shipped, such as Zanzibar copal, Madagascar copal, Sierre Leone copal, Congo copal, Manila copal.

The best and hardest grades are found on the islands of Zanzibar and Madagascar and in the coastal regions of Mozambique and former German East Africa, that is, on the East African coast. The material is a fossilized resin produced by certain varieties of what is known as the East African copal tree, such as Hymenaea Verrucosa and Hymenaea Mossambicense. The resin was formed as the result of injury to the trunk, branches and roots of extinct trees in bygone ages, by insects or otherwise, and on dropping or oozing into the ground, became covered, and slowly hardened or fossilized. It occurs in pieces of various shape, such as plate, pellets, tears, beads and irregular lumps, which vary in size from very small pieces the size of a pea to large masses weighing several pounds. It is collected by the natives who dig around in the ground for it in a rather haphazard, casual way, the deposits of resin being found only a few feet below the surface of the ground.

The Congo or West African copals, which are found throughout the coastal regions of West Africa in the districts known as Sierra Leone, Ashanti, Dahomey, the Congo country, and Angola, are not quite so hard as the East African varieties. The supposed origin of these sorts, also known as the copal tree, is a different tree from the East African copal tree, and belongs to the species known as Copaifera, one variety of which is called Copaifera copalline. The formation and method of gathering is much the same as in the case of the East African copals, although the copal

Cooper Shop. Making Barrels to Be Used in Transportation of Scrape.

Turpentine Storage Tanks at Still, With Barrels in Foreground.

forests are largely extinct where the best deposits of resin are found.

In both East and West Africa copals of more recent formation are gathered. These are not as hard and valuable as the harder fossilized sorts. Especially on the West African coast the natives gather the fresh resin from the trees, and allow it to harden by exposure to the sun. These varieties are not as valuable for varnish manufacture, being softer and more easily dissolved by various solvents.

Kauri resin, which is a form of copa'. and also highly prized for varnish making, is found in the ground on the islands of New Zealand and New Caledonia. Its source is the kauri tree, of the species Dammara australis, D. lanceolata and D. ovata. The formation and method of gathering is similar to the other sorts of copal, although the exploitation of the kauri deposits is being carried out in a more methodical scientific manner. As in the case of the African varieties, the most extensive kauri deposits are now found in localities where the forests of kauri trees have long since become extinct. The resin is usually found deeper than in the African deposits, and occurs in larger lumps.

Kauri resin of recent origin, which has collected at the base of kauri trees and hardened, is known as kauri bush copal or bush gum, and is used in the manufacture of shellac substitutes.

Manila copal is a collective term given to medium hard resins of recent formation found in the Philippines and other East Indian islands, whose origin is the so-called dammar pine or East Indian dammar tree, Dammara orientalis. It is also used for varnish manufacture. A variety of soft copal is also found in the West Indies and along the coast of Eastern South America, in British Guiana, Colombia, Venezuela and Brazil. The latter is not as hard as the other sorts of copal, and is rarely used in this country for varnish manufacture, although it is probably used for such purposes in South America.

So far as price and the possibility of replacing rosin is concerned, the copals are much more expensive than rosin. Recent New York market quotations for the various varieties of copals show that the price ranges from 17 cents to $1.40 a pound, depending on the kind and color, and also on the size of the pieces in which the particular variety occurs. The number of different grades, therefore, of the various copals is quite large. The copals are used for making high grade varnishes which must withstand wear and weathering, and for certain purposes their use is not greatly influenced by the price of rosin. That is, they have their own uses and for certain purposes cannot be replaced by rosin. On the other hand, due to technicalities of the varnish manufacture, it is improbable that rosin would be replaced by the copals, even at considerably higher prices for rosin.

Rosin Storage Yard at Still, Showing Temporary Storage of Rosin. In Foreground Rosin Barrel Staves Stored for Seasoning.

General View of Still Shed, Rosin Yard, Turpentine Storage Tanks and Railroad Sidings of an Up-to-Date Plant.

An Up-to-Date Plant Illustrating Turpentine Operations in the Southwestern Territory—Four Stills Under One Roof.

A LOOK AHEAD: A STUDY OF NAVAL STORES PROBLEMS

By Austin Cary, Logging Engineer, U. S. Forest Service.

[Mr. Austin Cary, born Machias, Maine, July 31, 1865, is still a legal resident of that State, although his work has made him a resident at times of various sections of the country. He graduated from Bowdoin College in the class of 1887, soon became interested in the science of forestry, then in its infancy in the United States, and in 1898 began his connection with it at the time when Pinchot and Graves and others since prominently identified with conservation and progressive policies were first endeavoring to educate American public opinion toward a saner and safer view of our forest wealth. Mr. Cary worked for the Forest Commission of Maine and the United States Division of Forestry under Dr. Fernow, also at timberland surveying and later at timber cruising, writing a good deal along forestry lines at the same time. From 1898 to 1904 he was forester for the Berlin Mills Co., now Brown Co., of Portland, Maine, and Berlin, N. H., surveying, mapping and cruising 150,000 acres of their 300,000 acres of holdings, and looking after the logging operations. For the five years ending 1909 he taught lumbering in the Forestry School of Harvard University. Since 1910 he has been with the U. S. Forest Service, working in many States including Oregon and Washington. He has lumbered somewhat himself in his native State and has owned growing timberland in Maine for the last thirteen years. Recently he has evidenced his faith in the possibilities of the South by the purchase of 600 acres of second growth slash pine in Florida. His work at this time in the Forest Service is to promote forestry among business concerns as far as it may be a good and practicable business. One of Mr. Cary's books, "A Manual For Northern Woodsmen," has passed through six editions since its first publication in 1909.]

THE present writer is invited, on the basis of a few months' close study of some problems of the naval stores industry and a rather wide acquaintance with its territory and personnel gained in the last two and one-half years, to write of present trends and probable early developments in the industry as they appeal to him. The market end is not covered in this paper; as to that, it is simply assumed that rosin and turpentine together with other products that the gum of pine trees is now or may in future be made to yield are staple and useful articles for which there will be permanent demand at suitable prices. It is the operating end of the industry and the raw material on which it is based that is under review.

Coming lately from among them, one thinks in the first place of the impression that will be made upon individual operators by the mass of information which this memorial volume contains. Historical and statistical articles, a review of helpful technical work that the Government in the past has done, accounts of the industry as developed in other parts of the world,—what that directly concerns him and helps make clear the course that he himself shall follow does the individual operator gain? That doubtless will vary vastly with the training, circumstances, and breadth of view of different men. In the western part of the field, in the States on both sides of the Mississippi river, turpentine men are mostly working ahead of sawmills, their operations strictly limited by the interests of others. In the East, the situation is freer and more diverse. Many remain of the historic type of naval stores operators,—those who years ago emigrated further south with near disappearance of longleaf pine in the Carolina country. Hardworking, rough-living, the pioneer type of men, their outlook of old was characteristically narrow. They trusted to others the sale of their product, stayed in the woods themselves, and for methods followed those of their fathers. So doing, they served in their day, producing from the native resources of the country a desired and useful product.

The methods of these men, too, perhaps suited conditions in their day; but of late years conditions have been changing. Chief among the changes is the decline in the volume of timber available and the change from virgin timber to second growth. Men have learned that second growth serves the purpose—is even more desirable in some respects—but the vast reserve of raw material, with the freedom and the sense of freedom it permitted no longer exists. New conditions, new considerations essential to success, now surround the industry.

Some under these changing demands have failed to respond and been eliminated; some, more agile of mind, have measurably adjusted themselves. More important, however, is the fact that a new generation of operators is in the field, men who have known no other conditions than the present. To these it is natural to look for leadership.

In a measure that expectation has been fulfilled. In South Georgia certainly, and doubtless elsewhere, are many men alert, active, and progressive. Some, the more independent intellectually and financially, are thinking broadly and freely. One sign of this, considered the most convincing that could be had, is the fact that within the last few years they have resolved to depend no longer on the leasing system and have bought considerable land areas. With this move goes naturally the resolve to get the most out of what is their own, an idea which automatically again stimulates longer range and greater breadth of view concerning the whole operation. Some, indeed, have the idea, for the most part general and lacking in detail as yet, that by the employment of suitable methods they can operate on the same tract perpetually.

This idea is certainly the idea to adopt, at any rate so far as it is practicable, for it implies maintained, stable industry, good alike for the operator and for the country. The present article is largely devoted to its examination from a viewpoint, it may be said at the outset, that is positive. It appears to the writer that plain considerations of good business in the turpentine industry call for the adoption of much of this idea, and not only so but that the time is not very far ahead when it will no longer be possible to run successful business without it. If at first glance that seems like a threatening situation, there is, nevertheless, a hopeful side; indeed, it does not seem too much to say that for such members of the producing industry as may see the situation straight and rise to the occasion the best days are ahead and not behind. From the viewpoint of such men absence of a mass of raw material that costs nothing and is valued at very low figures, a constant stimulus to overproduction, may well prove an advantage rather than otherwise.

Some men are seeing the matter that way and within their own knowledge have numerous facts in store that back their opinion. For instance, an operator some years ago, finding himself unable to buy a new place such as he wished, turned round, went to studying his operating methods with great care and learned so much by it that he made more out of the old place than he had formerly been able to do out of virgin timber. That is one man's experience. Many have either experience or observation in a somewhat related line,—

Just an ordinary view, so common, in fact, that few ever stop to give it consideration. To most a tick-ridden cow or razorback hog appears more valuable and interesting. The question is put up, however, if a good share of the future wealth of the South is not to be based on exactly such elements.

prolongation beyond all expectation of the life of operations. Places bought for 5 or 6 years operation have lasted a dozen or 15; others sold out as being exhausted have been worked by other men longer periods and to greater profit than they had been by the former operators; stills have run continuously at the same site for 20 years and more, and no end in sight yet—these are facts familiar enough to the observing. Correct interpretation, too, is not difficult. Miscalculation was probably not the cause in the majority of cases. Efficiency of operating methods has played a part. But the main factor was growth of timber—new growth that started and came to commercial size unaided, sometimes unappreciated. This new growth men are now willing to consider on its merits as a factor in the case.

The practicability and profitableness of the business of growing timber and of producing naval stores from it will depend on two sets of considerations: The degree in which natural conditions are favorable and the operating methods used. Consideration of the French industry, an account of which is found elsewhere in this volume, will serve as a stimulus and for comparison. That industry, though younger than ours, is on a sustained, permanent basis. By all accounts, too, it is profitable and satisfactory to those who conduct it. Agreeing, then, that Americans ought to be able to do what has been done by men of another nationality, we might nevertheless fall into error if we tried to pattern after them exactly. To build up the business on a sound basis, we should make our own plans and make them with an eye to conditions immediately around.

What about those conditions in a broad way, however? Have the French anything better than we have in the way of tree species and soil conditions? Not as good, according to the accounts that come to us. The soil on which those pine forests now grow was, a hundred years ago, either swamp or sand dune, comparable to the poorest of our available territory. Maritime pine, by accounts, is no better as a resin producer and not as good for lumber as our own species, slash and longleaf. In respect to rapidity of growth their territory appears distinctly inferior to ours. Slash pine on our ordinary soils frequently reaches profitable bleeding size in 20 years, the same stage that their tree reaches in 30; from the period taken by them to produce merchantable saw timber it looks as if we could cut a third or half with our own species. Then we have strong and abundant natural reproduction of timber and great areas of young forest already started, while they had bare land to start with and had to begin by planting. Relative area also gives inspiration for the future. The gross area covered by the turpentine forests of southwestern France if set down in the State of Georgia would cover but four of its southwestern counties. Fair consideration seems to show, therefore, that so far as natural conditions are concerned, not only is there nothing in the way of the southern pine territory's maintaining its lead in the production of the world's naval stores, but that it has advantages that are exceptional.

A share, too, of what in the way of suitable technical methods the industry has required to put itself in line with the new times has already been accomplished. This is mainly true, for instance, of the method of box cutting. The box makes a deep wound in the living tree that may cut off a portion of its means of nutrition, that so weakens a tree of small size that in many cases it breaks over, and that exposes the support of the tree to subsequent destruction by fire. Those familiar with the territory need no evidence or reminder of the vast detsruction of timber and of values that was worked in former times by this means or of the fact that it is now operating to a considerable extent on second growth.

In showing that the box, as well as being destructive of timber, was a wasteful and inefficient method technically, Dr. Herty did a great piece of work. And it is no sound objection to the system that because two cups could often be hung on a tree that would carry only one box, much young timber has been overworked and destroyed in consequence. The method in itself was a big advance, a requisite to real progress. And the Government, through Dr. Herty, was responsible for one more big advance in showing that the heavy chipping formerly general among operators stood on like ground—was both inefficient technically and damaging to the timber.

Tardily, it would seem, yet steadily, the industry during late years has been adopting these improved methods until at the present time, taking the field as a whole, their employment is general. They do not, as Dr. Herty himself recognized, and as every thinking operator knows, cover the whole area of reform that is needed. The size of tree that it is profitable to bleed, the time it takes a tree to grow from the unprofitable into the profitable class, just what style and severity of working will get the utmost yield out of a tree in a given number of years, and what other methods may best be employed if the intention is to preserve the tree's health and thrift for future yield—these are questions pertinent to the case; also they are unsettled questions. Some few, indeed, have studied them, and with effect, arriving at conclusions which they embody in their own practice. This is unusual, however; a fluid and inquiring condition of mind is general. Meeting these questions in the current of affairs, the writer has of late been trying to throw light on them through studies of a detailed and trustworthy kind. Before recounting the results of these studies, however, brief and fragmentary only as they are to date, it seems necessary to develop one more side issue.

An old and widely known turpentine operator lately stated to the writer in the field that that day for the first time in his life he had thought of naval

stores operation as related to anything but itself, particularly in connection with the final harvesting of timber for use as lumber. That is probably not the usual state of mind, but it may be common. It is one which in the opinion of the more thoughtful fails largely of meeting either the obligations or the opportunities of the industry.

The rising price of leases is a sign patent to all; and the near exhaustion of supplies of old timber in the eastern territory, the Carolinas, South Georgia, and North Florida particularly, is a fact well known to those located in that territory; likewise the vast destruction worked by the industry in the young, second growth timber. In the West, in Mississippi, Louisiana, and Texas, the industry is now flourishing on virgin timber worked a few years for turpentine in advance of saw-milling. This branch of the industry, however, is considered by those in the trade to have reached its maximum of production. However that may prove, affected as it may be by prolonging the period of the naval stores work and by supplementing its products with those from stumps and lightwood, the fact remains that rapid shrinkage is taking place in the volume of virgin timber which supports the industry in this region. A country-wide census by the U. S. Bureau of Corporations in 1909 and 1910 developed this fact, which has lately been confirmed by a review by the Southern Pine Association of pine resources in the States from North Carolina to Oklahoma and Texas. These studies reveal that there is in existence less than 20 years' supply of virgin pine timber for the present mill output of the South; and the prediction is made that, beginning at the present date, mill output will shrink until, at a period that may be 15 or 20 years from now, a low point of production, mainly sustained by growth, will be reached at about half the present output. This spells different prices for lumber and stumpage than have been habitual; and further, because new growth of timber is much less prevalent and satisfactory in the West than in eastern territory, it means opportunity in particular for men in the East who are now, or may early come to be, in control of land with timber. Is any other conclusion to be drawn but that good business policy demands the clear recognition of the above facts and careful consideration by the industry of methods such as will yield not only naval stores but a final crop of timber fit for the saw?

Some are liable to error because of misapprehension in respect to quality of lumber. In the past, because native timber was so plentiful, southern domestic users considered only heart pine lumber suitable for use, because, unlike sapwood, it would stand the weather unpainted. This can not much longer apply; for heart pine soon will no longer exist in quantity. We shall find ourselves both unable and unwilling to

Slash pine on clay bottom soil in Florida, paralleled at many points. At 17 years of age the trees are around 45 feet tall and up to 8 inches in diameter. Could hang about twenty fairly profitable cups to the acre now, and by keeping after it in the same way get quite a yield of naval stores in the aggregate, finally crippling or destroying the timber. Could also wait several years before operating, when the grove would likely take 150 cups to the acre and cut, after bleeding, ten thousand feet of small dimension lumber. That looks like a better proposition. Could also do a third thing which it is possible, if well managed, would prove more profitable than either of the above. Could pick a certain number of the most promising trees, evenly spaced, not to be bled till they can easily stand it and then conservatively and with care, so that at perhaps 40 years of age they may make heavy timber. Work the rest with the idea of getting the most gum out of them and thinning the grove, too, so that the picked trees may the quicker reach their development. That, and making sure that there is a supply of young timber to treat this way, is the essential thing about the French system.

Eight years older than the above, but on soil that has pushed the trees ahead a little faster. At 25 years of age these slash pines, grown up in an old lake bed, are 75 feet total height, and numbers of them from 10 to 12 inches in breast diameter. On picked acres 200 cups are hung and twelve thousand feet of lumber could be cut with suitable outfit.

What boxing and the fires finally did to twenty thousand feet to the acre of serviceable pine timber.

Second growth going the same road, though not in this case from boxing, but by reason of two faces back to back.

Chipping guided by vertical lines cut with a hack and chalked. The Mississippi concern in whose work this picture was taken took up this practice to protect themselves under their contract with the sawmill concern whose timber they were working, but continued it for the benefit they themselves derived.

wait for its reproduction, and be obliged in consequence to adapt ourselves to the use of sappy and knotty, because quickly grown, material. We can readily do this, as other countries and other sections of our own have done before us, and the same thing holds with lumber for other uses, such as railroad ties treated with preservatives.

Thought of the forest as stationary—the lack of a realizing sense of the fact and the rate of growth of timber—hampers many, and this is the greater error in conditions as generous as those of much Southern forest. Cases are known where timber has reached a size such that it was bled at 8 and 10 years of age, and on much territory it is profitbaly worked at 20, having reached also at that age a development which would make it serviceable for such uses as pulpwood. Well conditioned young trees frequently grow an inch in diameter in two years, passing thus in four to six years from the size at which when worked they barely return expenses into the class that is really profitable, and paying handsome return on any fit investment. At 25 years on some soils slash pine standing not too open or dense reaches sizes at which it yields a heavy cut of useful lumber per acre and for the two species, slash and longleaf, 30 to 60 years may be given as the range required in usual conditions. These periods may seem long when casually looked at, but the question of profit turns on comparative advantages, and here the Southern country is hardly excelled by any. This fact has been referred to already, but is hardly likely to receive too great emphasis. Southerners in general may need the reminder that several classes of people in New England and some other sections of the country find timber raising a very satisfactorily paying business, while their own section has a great and especial advantage in having timber trees from which revenue may be derived, through turpentining in the growing stages.

The rest of this paper is mainly given over to the technical points earlier suggested, which relate to present day efficiency and to the future of the industry as well.

First let us consider the yield of gum from trees of different sizes.

Below is the result of the first set of observations made, April 19, on young longleaf timber in the first year of working, at a point in Wayne County, Georgia. From 15 trees of each size that was abundantly represented, the cups, then ready for dipping, were removed, weighed with a spring scale, and the weight of cup deducted. Average weight of gum for each size of trees is given, and significant relations in percentage. The low comparative yield of small trees is striking; above 10 inches in breast diameter, the yield, as far as these figures show, does not gain with anything like the rapidity shown in the smaller sizes.

Yield of Gum from Young Longleaf Timber, First Year Working, Ready for First Dipping.

One-Cup Trees.

Diameter breast high	7 in.	8 in.	9 in.	10 in.	11 in.	12 in.
Width of face	7 in.	8 in.	9 in.	9½ in.	10 in.	10 in.
Yield	10 oz.	10 oz.	19 oz.	22½ oz.	23 oz.	24 oz. (4 trees)
In per cent. of 10-inch trees	44	67	84	100	102	107

Two-Cup Trees.

Diameter breast high	10 in.	11 in.	12 in.
Width of faces	9 and 9½ in.	9½ and 10 in.	10½ and 11 in.
Yield	36 oz. (6 trees)	43 oz.	48 oz.
In per cent. of one-cup trees	-|- 60	-|- 87	-|- 100

Between the date given and May 28 observations of this kind were carried on at a number of points in South Georgia. The results in general were not so regular as the above (operators know very well that there is much unaccountable variation among trees of the same dimensions and appearance), but with the same result in general. Comparative width of face on large and small trees does not account for the difference found in yield. A tree has to have some size in order to yield gum at a good rate, one giving generous reward for the labor expended.

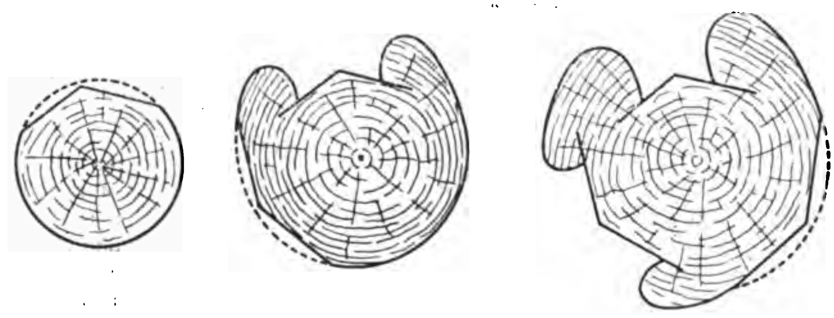
Carried down to smaller sizes, the figures obtained are still more striking. Longleaf timber was in fact found, and as late as May 12, that, being worked the third year, had an average of but one ounce in the cups after four streaks had been applied to the faces. At that rate a cup would not fill in a whole season. No conclusion seems possible, but that on any market a loss of money is involved in the working of such and many other faces.

Yield varies, as has been stated, among individual trees; also no doubt, it varies with soil, with crown area, and with other factors, in all likelihood mainly according to the accumulated observation of woodsmen. Sufficient time has not been available as yet fully to test these matters. Nor is the set of figures next presented to be regarded as widely based or final. It simply records the general upshot of a number of records to date, on first year timber early in the season. Because sufficient records are not at hand to treat the two species separately, slash and longleaf have been grouped together; although there is reason to think that, in the small sizes at any rate, the flow of the two may be quite different. From the figures it appears that a tree seven inches in diameter, breast high, runs only half as much gum as one of 10 inches, while a 5-inch tree runs only a quarter as much as the 10-inch; yet, as is well understood by the industry, just as much expense is involved in working the smallest as the largest of the three sizes. It seems certain that this point is not sufficiently considered in connection with the value of leases. Two other inferences bearing immediately on the economics of the industry also result; first, that there is a size, below which it does not in any circumstances pay to work timber; second, that, considering the rate at which such timber frequently grows, the owner who works it at too small a size is cutting off a very handsome investment.

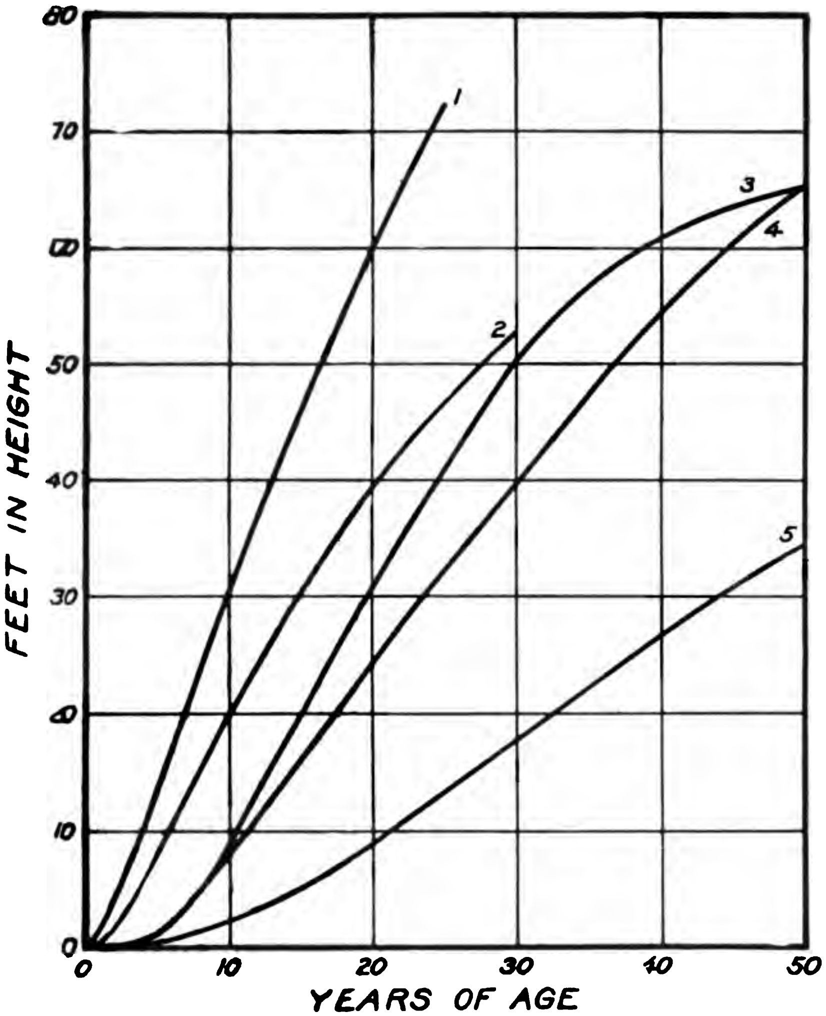
Yield from one face on trees of different sizes (diameter breast high), first year, early in the season, in ounces of gum relatively:

Diameter, 5 i nches; yield, 4 ounces.
Diameter 6 inches; yield, 6 ounces.
Diameter, 7 inches; yield, 8½ ounces.
Diameter, 8 inches; yield, 11 ounces.
Diameter, 9 inches; yield, 14 ounces.
Diameter, 10 inches; yield, 16½ ounces.
Diameter, 11 inches; yield, 19 ounces.
Diameter, 12 inches; yield, 21 ounces.

The set of figures first introduced, on page 12, is related also to the second point of inquiry, comparative yield among the smaller sizes of trees of one and two faces. On this point the suggestion made by the first observations that 12 inches in diameter breast high is a size at which two faces may most profitably be worked because twice as



THREE SUCCESSIVE WORKINGS OF A GROWING PINE.



Height Growth of Slash and Longleaf Pine in Comparison with Northern New England Timber Trees.

1. Sash pine on old fields and some other sites.

2. Slash pine on an ordinary site in Clinch County, Ga.

3. Longleaf in Camden County, Georgia.

White pine on old fields in Massachusetts. This timber has been giving heavy money yields for years, ($200 to 300 an acre at 40 or 50 years of age in some cases) and is prized very highly in consequence.

5. Spruce at a point in Northern Maine. Growth of about this kind is what the northern paper industry has to depend on.

much gum is obtained as from one face, while smaller sizes yield a less and less proportion progressively, proved not to be confirmed by other observations. Twelve-inch trees with two cups did not in general do as well as this relatively; and the point at which timber so worked gives the same return for the labor put out as does one face must apparently be raised by two or three inches. On this point the records obtained show much irregularity and some unexpected relations that can not now be explained; but the general drift of all observations made is to the effect that in the case of trees 10 to 12 inches in breast diameter (the smaller sizes so treated in the practice of most operators on second growth in South Georgia) about 70 per cent. is added to yield by the second face. This is for first year timber and early in the season. The draft on vitality created by double cupping carried on through a series of years is another matter, one not as yet tested by the method. Operators are, however, perfectly aware of the results of this style of work as it is frequently conducted. Bars cut through that reduce the trees' means of nutrition, trees so heavily bled that they dry face and fail before the working period is completed, trunks left so thin by reason of faces set back to back that there is no possibility but that sooner or later the trees must break over, the unwounded surface of living tissue left so restricted that there is no chance of their ever holding another cup—these conditions are perfectly familiar to the observing woodsman; also the inference has been widely drawn that such departures from sound and effective methods as prevalent as they are today must vitally affect the success of business when conducted on a normal margin. A striking illustration of the effect of care and system applied to this and other points comes from Florida, where the new manager of a large operation, by cutting out the small trees, by double cupping only the larger timber, and by more conservative chipping, raised the yield from 30 to 50 barrels per crop, brought his timber through in much better shape to the saw, and as far as can be told by the records got a greater actual quantity of naval stores per acre and section of timber.

There is another relation, vital to the broad forward-looking program earlier outlined, in which this matter of severity of work must be considered: its effect on the t hrift and growing power of the timber. Here the findings must be compressed into a few sentences. A considerable volume of detail work has, however, been done. A good many trees found bled in different ways, immediately or some years after conclusion of the operation, have been felled, cut into sections, and their growth measured in diameter and height as affected by the bleeding. It appears that the majority of trees do sustain some check of growth even with but one ordinary face put upon them. This check may amount to one-third the normal growth on the average. It is least, sometimes not discernible, on trees standing open and with large leaf surface. Such trees, and many of ordinary type, largely recover from it soon after operation ceases and begin to lay on wood with especial vigor in the neighborhood of the face, thus at the same time healing the wound, meeting demands for the

trees' nutrition, and forming a surface especially favorable for later working. This last is a feature which it is thought will be given strong consideration in the careful system of operating which is foreseen, and the idea has been illustrated by a diagram. One face on thrifty timber 9 or 10 inches in diameter starts the formation of a swelled butt more or less elliptical in cross section. On this, after a few years rest, a face larger than the first may be placed; it should be set much nearer one side of the old face than the other so that the two shall be at an angle. With conclusion of the second working period the same process of recovery is renewed, soon giving opportunity for a third face between the two preceding. With this, the working surface will have all been used, and the tree should be cut for lumber. Using this general plan of operation, numerous thinking men are convinced that much of the young timber of the eastern territory can be kept steadily growing with fair thrift, made during a period of 20 years to yield three crops of naval stores, and brought to that final use which seems natural, and which should be profitable as well, for lumber.

Two faces placed simultaneously on trees of the ordinary second growth sizes have an entirely different effect upon them than has one face. The effect on yield of gum and the mechanical damage to the tree which this method as commonly applied entails have been dealt with already. Over and above that, however, is the effect on growth itself, which in the great majority of cases is heavily depressing. The broad rule on this point derived from several weeks' study was that the growth of trees smaller than about 13 inches in diameter breast high was minute after they had been worked with two faces. Unless these are applied with the greatest care, it would be better in many cases to bleed such trees out deliberately, kill them, and let their room be taken by new growth of timber.

The detail work done to date is only a beginning. Other points on which suggestions at least have been derived could indeed be covered, but it seems better to omit that until they can be treated with more assurance. For the present purpose it seems more worth while to apply the ideas already gained to some sets of practical conditions. Some that are forcibly suggested by observation in the field are as follows:

Fire Sweeping Through a Turpentine Farm.

1. Simply to hold timber till it is suitable to work is one feature of good management, and in certain conditions the most important and most profitable of them all.

2. In contrast is the consideration that some stands, bled out, over-crowded perhaps, from which little or no further growth is to be expected, had best be got out of the way so that the ground may come up to a new crop of timber, and the quicker the better, subject only to market considerations.

3. A type of forest that is important and rather widely represented is the young timber just coming into the stages profitable for one cup operating, and at the same time not too crowded and thrifty. The general treatment suggested for such stands is to bleed the profitable sizes carefully, with one face only, to not over six feet from the ground. Such trees in general will stand the operation well and after a rest of three or four years be ready to take a second face, which may be wider than was the first one. On much timber it will be good policy, after another rest, to repeat the process a second time at the end of which period bleeding surface will have all been used and the tree, having reached the size of 14 inches or larger in breast diameter, may be cut for lumber. Such trees should scale from 80 to 150 feet, and it is possible for them to stand 100 or more on an acre.

4. A good deal of irregularity in size and age is general in second growth, and natural treatment of such stands will result in maintaining forest with bunches of unlike age, some not yet workable, others in one or another of the working stages. Forest in that form is fairly productive and lends itself readily to profitable operation. After some surveys of stand and growth on representative area in South Georgia it was estimated that the yearly product from well treated forest standing in this form might be the equivalent of anywhere from three to 12 faces working constantly, with an annual product of from 100 to 400 feet of lumber per acre.

5. Stands too dense to grow well are found widely, and while present practice of bleeding indiscriminately anything that may be bled does secure some return, and that sometimes continued over a considerable period, it looks, considering their great possibilities, as if better treatment should be profitable. Thinning in the very young stages would be effective here, and the French sys-

tem of management makes further suggestion, the system of thinning young stands by bleeding a portion of the trees to death and so making room for the development, for later turpentine working and for use as timber, of trees selected beforehand as being the more promising. Plenty of natural stands afford first-class facilities for this operation, needing only technical judgment to put it into effect, and a demonstration of its practical advantage to the operator and land owner.

6. The idea of planting trees may seem at first sight entirely impracticable, also unnecessary under the local conditions, but no harm will result from giving it a little consideration. Old worn-out fields, features on most timber properties, furnish one ready opportunity for planting. The advantages of the method consist in getting what one wants, in saving time, and in securing the most favorable development of the trees through correct spacing on the ground.

A slash pine 9 or 10 inches in breast diameter and 45 to 50 feet tall is a good turpentine tree, at one face per tree not less than 40-barrel timber probably. Old field soil will produce such in 15 or 16 years and trees of that size and age will stand 10 to 12 feet apart in all directions, or say 350 to the acre, at which rate only 30 acres are required to make a crop. The value of this per face or per cup men may reckon according to their own experience and judgment; on any fair basis it comes to several dollars per acre of return yearly. Nor are the possibilities of the case thus exhausted, for such timber would be serviceable immediately for such purposes as pulpwood; or, after thinning by methods already suggested, a share of the trees might be brought along for further bleeding and for final use as lumber. The enterprise, in fact, looks highly attractive to those well situated to try it. A systematic method of computing cost is illustrated in the following computation made for the benefit of a paper mill concern planning to go into just this enterprise in circumstances somewhat less favorable than those above contemplated:

Estimated cost of slash pine plantation at end of 20 years; possible yield of wood 30 cords.

Cost of bare land per acre	$5	
Cost of seeding to pine	5	
		$10
Compounded for 20 years at 5%		26.53
Taxes and protection at 50c yearly		10.00
Compound interest on last		6.53
		$43.06
Deduct land value		5.00
		$38.06
Per cord, omitting turpentine value		1.27

Partially developed, in fact only foreshadowed, the case must be rested here. The writer, vastly attracted to the country in question and full of enthusiasm as to its future if only in the development of that future sound knowledge and good judgment are applied, has endeavored more than anything else to stimulate a forward-looking attitude in those on whom that future so largely rests. New times, new methods—that is the idea—based, as were those of the past, in so far as they were serviceable, on a clear view of the real factors of the situation. Such adjustments must always be made, and rewards come in fullest measure to those who most promptly and successfully make them. Not that the task is easy always—management of labor and a degree of control of the fires now so prevalent are difficulties in the present situation that loom large. They are not insurmountable, however, and it is thought will in fact appear small to those who fully realize the stakes in the game. Much more in the line of careful investigation it is believed would be highly useful in the present case. Further than that the essential thing is to go ahead on lines carefully thought out and in accord with the best information at hand. Assurance and order will result if at each stage men do the sensible and promising thing.

PROPER METHODS OF DISTILLATION AND HANDLING IN THE PRODUCTION OF TURPENTINE AND ROSIN

(By Robson Dunwody.)

[Mr. Robson Dunwody was reared in the naval stores producing territory and became acquainted with the industry at an early age. After taking an engineering course at the Georgia School of Technology, he became connected with several naval stores concerns, especially with regard to the development and marketing of improved distilling apparatus. In this connection he became a close student of the several phases of the work in the woods, especially studying distilling problems at the plants and in laboratories. In 1913 he became connected with the Gulf Naval Stores Supply Co., of New Orleans, a concern leading developments in improved methods. He is now President and General Manager of this company. Mr. Dunwody is an aggressive campaigner for the most scientific methods in the industry and has done effective work in demonstrating their value to the turpentine operators.]

HISTORY. The earliest records of the distillation of crude resin date back many centuries B. C., when the natives of ancient Asia manufactured pitches and oils from resin of trees that grew on the far shores of the Mediterranean. This resin was placed in pots and cooked down to a thick pitch: fleecy sheep skins stretched over the pots would condense and hold the rising vapors of the oil which distilled out of the resin. This oil was recovered by wringing out the fleeces and was used in some of the arts and industries of those days,—such as in the manufacture of age-enduring mummy varnish. The residue left in the pot was pitch; and it is recorded that in building the Ark, Noah was commanded to "pitch it within and without with pitch."

The production of crude pine resin, pitch and tar in this country, dates back at least to 1600. However, the first records of importance start about a century later. At that time the resin was gathered by various methods from the pine trees of Virginia and Carolina and was placed in clumsy pots or kettles and heated until a large portion of the volatiles had been driven off, and a pitchy mass remained. As much foreign matter as possible was strained out and this pitch was used in caulking the joints or seams of wooden ships; also, tar and pitch made from rich resinous wood or "lightwood" was largely used in ship building and repair and for fixing sails and tackle. Every vessel and every shipyard, of course, carried these products as important supplies or stores, and practically the entire output was used in the shipping business,—so, pine rosin either in its raw state, or cooked or burned into pitch, and the tar and pitch made from "lightwood," were given the name of "naval stores." With the growth of the colonies a mediocre industry grew up along the middle Atlantic coast and slowly extended south. The methods and equipment used were of the crudest possible sort, with little thought of improvements or expansion of the variety of, or uses for the products made.

Later, the crude resin or gum as obtained from the trees and shipped to the markets, was cooked in enclosed iron retorts, and a portion of the volatile oils—which had heretofore been allowed to go to waste—were condensed and saved. This product was called spirits of turpentine, or oil of turpentine, and was used extensively as an illuminant and as a solvent or thinner for other materials. The distilleries were located in the leading markets, as Philadelphia, New York, London, and later in Norfolk, Va., and Wilmington, N. C. These distilleries bought the crude resin from the South and sold their finished products of turpentine, rosin and pitch to the consumers and exporters.

In 1834, the copper kettle and condenser worm—of the kind used for distilling malt—was introduced to handle crude resin,—the outfit being practically the same as that in use today. The resin was put in these kettles and cooked until the spirits of turpentine had stopped coming over. The residue left in the kettles was generally sold as pitch, but sometimes no market could be found for it. The turpentine during the first part of the run was clear white turpentine, such as the commercial turpentine of today,—but during the latter part of the run gradually changed to a dark amber color and was sometimes thick and heavy. Later, a certain portion of water was added to the resin at the time of putting it in the kettle, and in this way a larger percentage of white turpentine could be obtained and the residue was more merchantable.

In these years the industry grew steadily, and while the spirits of turpentine found a ready market, not enough use had been developed for the residue; so, only those distilleries most favorably located could sell it at a profit, and a large part of this product—now known as rosin—was thrown away, and that used for naval stores purposes was re-treated to make a material such as was desired. Turpentine soon shared the fate of rosin, over production lowering the prices to an unprofitable point, many distilleries closed down and others were formed to move nearer the source of supply of crude resin to enable greater economies in operation.

About 1850 the general industrial development all over the world was making new uses and increasing the demand for both turpentine and rosin, causing a revival of and a substantial increase in their production. The business was still carried on as a sort of family farming affair, but the amount now made was considerable and the industry was firmly established. The methods of working the timber,—such as "box" cutting and "hacking" (chipping), and the crude product obtained, were now fairly standard. There was also further effort to improve the distillation, the rosin being strained through wire and rough cloth or burlap and classified into several grades, the light colored clean product bringing the highest prices.

As a rule, the timber or trees from which the crude resin was obtained, was of small value, only that close to transportation being at all saleable. Even under these conditions, the injurious effects and waste of box cutting was under serious discussion, and in 1869, A .Pudigon—an operator of Monks Corner, S. C., tried out a rough form of the present cup system, but was unsuccessful in having it adopted, probably due to its unfinished design, but more likely to the prejudice of the producers of those days against innovations.

Late in the nineteenth century, as the industry expanded westward into the extensive and now valuable forests of Alabama, Mississippi, Louisiana and Texas, better methods of timber operation were demanded, and there were many efforts to work out a system that would do away with the gum receptacle or "box" that was cut with a long-bladed axe deep into the trunk of the tree, and into which the crude resin or gum flowed from the hacked face above.

In 1895, J. C. Schuler, of West Lake, Louisiana, made a practical and partly successful test of the cup and gutter, patented after the French method, but improved to allow the working of a wider "face." The experiment was very expensive and its backers would go no further with it after a short trial. However, it is probable that they would have been entirely successful and received the necessary encouragement, if the test had been brought to the attention of more naval stores manufacturers. About ten years later the "cup and

gutter" system was successfully introduced and soon thereafter the "cup and apron" system was put on the market. These systems are now in general use in all parts of the pine belt and "box cutting" is now practically unknown over the greater part of the belt.

The Government, through its proper departments, has carefully studied and made many valuable suggestions for improvements in timber conservation and the methods of gathering and handling crude pine resin and its products. In late years, these efforts have met with ready response from the progressive naval stores producers, and many of them are rapidly installing the new appliances and processes, and have greatly advanced both the quantity and quality of their products,—putting their business on a substantial profitable basis independent of unusually high markets.

DISTILLERY APPARATUS AND METHODS. The copper kettle and worm and general arrangements of the average distillery, have been substantially the same for the past seventy-five years. The kettle or still itself ranged in capacity from 400 to 1,000 gallons,—its average size being about 7 feet at its greatest diameter by 5 feet high; with a concave bottom and a semi-spherical top having a round opening some 22 inches in diameter fitted with a removable hood or goose-neck for carrying the vapors over to the condenser worm. The worm is made of copper tubing 6 to 8 inches in diameter at the inlet and tapering to 3 inches at the outlet. It is about 140 feet long formed into a coil of seven turns about 6 feet in diameter by 7 feet high, and is submerged in a large wooden tank connected with running water; the outlet of the worm being near the bottom of the tank and suitable arrangement being made to catch the distillate.

The kettle is set in a circular brick furnace fitted with proper flues and is fired direct with 4-foot cord wood There is an 8-inch opening in the side of the kettle at the bottom; the tail pipe, or outlet for the residue or rosin is riveted to this opening, extends through the furnace wall and is fitted on the outside end with a quick opening slide valve; connection being made by a trough to a succession of wire cloth strainers placed over the rosin vat. Except at the most advanced plants, the basic features of the distillation are carried on about the same everywhere, the kettle being filled with crude resin to about 75% of its capacity, the furnace fired up, and the distillation starting as soon as the mass reaches the approximate boiling point of water. The distillate composed of water and spirits of turpentine is caught in an open barrel, turpentine being of the lower specific gravity, floats on top, and is from time to time dipped off into barrels. A small continuous stream of water is introduced into the still after about one-third of the distillate has come over, the exact time for adding the water being left to the stiller who sounds the end of the worm and adds the water when in his judgment the free water in the gum has been cooked out and the ebullition in the kettle has reduced to the required point. A good fire is kept under the kettle until the percentage of turpentine coming over with the water or low wine is too small to justify further firing. The water is now cut off, the still uncapped, fire withdrawn, and the charge turned out into the strainers; filtering through them into the rosin vat below. The strainers are removed and the rosin dipped up into barrels.

SOUND DISTILLATION. The average "stiller" using the common method of sound distillation, has had very little opportunity to learn anything about the chemical or physical principles involved, and he works by more or less haphazard ideas and traditions handed down from father to son. A careful effort to find out the "reasons" of the practice of sound distillation revealed the following information. As stated above, this information is practically unknown to the "stiller," as he works from effect with very little knowledge of the causes. However, anyone interested in acquiring the knowledge of turpentine and rosin manufacture should know the principles or reasons underlying sound distillation, as these same principles, correctly applied and controlled, form the basis of modern methods of thermometer distillation.

The pine resin as it comes to the still contains more or less free water; this depending on the amount of exposure the gum has been subjected to, and the rain fall that had taken place prior to dipping Of course, on heating the resin to the boiling point of a mixture of turpentine and water, which is slightly below the boiling point of water alone, the free water and the turpentine which is in the resin, is converted into vapor as fast as the necessary units are supplied. This vapor, being partly imprisoned by the viscous resin, greatly increases the volume of the mass and violent ebullition takes place. The "stiller" by "sounding" at the end of the worm can get a fairly definite idea of the height and condition of this "boiling up" in the kettle. He endeavors to so add the fuel that the vapor is carried over into the condenser at such a rate as to prevent an undue increase in the volume of the mass. If he does not "keep" enough fire, the cooling mass grows more viscous, thus imprisoning more vapor and increasing the volume, —and finally causing the still to boil over with an attendant loss of resin and danger of fire,—at the same time he must be careful not to add too much fire, as a superabundance of vapor in the mass, without a proportionate decrease in viscosity, would have the same disastrous effects.

The ebullition in the kettle gradually reduced as the free water is "cooked out," the amount of distillate grows correspondingly small, and as the foam subsides and the mass in the kettle gradually grows "level," a small continuous stream of water is introduced through an aperture in the cap The "stiller" now sounds carefully and the fire and water are increased or decreased according to his judgment of the condition in the kettle, the idea being to attempt to supply enough heat units to convert the water and turpentine into vapor and carry it over to the condenser at the proper rate. Too much fire must not be added as the water would be driven out of the mass too fast and it would rise very rapidly; and if not enough fuel was added, the temperature would fall, the mass grow more viscous and greatly increase in volume from the imprisoned vapors, and there would again be danger of boiling over. The amount of water being introduced is, of course, regulated with the same general end in view.

The practice in general is, that when the mass is high in the kettle the still is called "cold"; when the mass is low in the kettle it is called "hot." This "cold" and "hot" is qualified by the foam as the "stiller" judges it. If he thinks it is high and filled with large bubbles and is roaring and flopping, the still is very cold and needs heavy firing. If the foam is medium high and smooth, the still is running all right. If the foam is low and smooth, the still is "hot," and needs more water. If the foam is very low and giving forth a frying, hissing sound, the still is very "hot" and more water must be added and the fire reduced.

The volume of distillate is also a factor to be reckoned. If it decreases suddenly, the "stiller" knows that not enough heat is being supplied to bring over the vapors and that his still is getting "cold." Also, the proportion of spirits of turpentine in the distillate is considered to a small extent in determining the amount of water to be added. The effort is to keep the mass medium high in the kettle with a smooth foam and to have the distillate come off with about equal proportions of water and spirits of turpentine, and to run a steady stream; when the proportion of spirits of turpentine in the distillate gradually grows small showing that the charge is reaching the end point, the still is generally fired a little heavier, in order to bring the residue or rosin up to what was judged a good heat to strain.

There are also untold superstitions and so-called secret methods of trying to judge the condition of the still during its operation. Some of these methods are almost ridiculous when analyzed but this is not surprising when it is considered that up to a very few years ago, practically no scientific information at all was available along these lines, nor can it be denied that the prejudice against improvements made progress very slow.

Of course, this whole method of sound distillation is more or less guess work

at the best, and produces very uncertain results in both quantity and quality of product. As stated before, the "stiller" is not familiar with the scientific principles underlying what he is trying to do, and there is no guide or aid of any kind to help him or to standardize the distillation,—the apparatus and distillery house and arrangements generally being the crudest and cheapest possible, with waste and dirt everywhere. Fire losses were frequent and very large.

Under this system, the "stillers," as a class, undoubtedly received the poorest pay known for any position of like importance and responsibility. In fact the average "stiller's" salary was less than $75.00 per month in 1917, and a distillery complete, building and equipment, cost under $1,500.00 To this outfit the average naval stores manufacturer turned over his entire crude product made at the cost of many thousands of dollars,—and his profit or loss depending almost entirely on the efficiency of his "stiller" and the apparatus he had to work with. Yet the advancement or reward of individuals because of better methods introduced or results obtained, was seldom encouraged. As a consequence, few men of technical or other training particularly fitting them for this work, were attracted to the industry, and this has no doubt accounted for the slow progress along these lines, that has always characterized the manufacture of naval stores. There has, of course, been many notable exceptions to this statement, and many "stillers" have produced remarkable results, considering the facilities at hand to work with, and many earnest efforts were made from time to time to improve these methods. However, it is not too much to say that exclusive of preventable fire losses, millions of dollars have been lost in unrecovered turpentine and in making low grade rosin out of high grade resin,—all because of the lack of scientific apparatus to guide the "stiller" and to govern the several operations.

The products of sound distillation will always necessarily be uncertain and lacking in uniformity, with large losses to the manufacturers.

Crude as the American method appears to the casual observer, nevertheless careful study of this system as compared with the much more expensive systems in France has convinced the writer that, given a good stiller, equally good results are obtained by this very inexpensive outfit. Of course, the presence of the personal element, as represented by the stiller, is always a risk in manufacturing operations, and it would seem to be a needless risk in the light of its complete elimination in the French system of "mixed injection," where heating is effected partly by free flame and partly by steam; where water vapor is furnished both by inflowing hot water and by direct injection of steam; and where operations are controlled entirely by the thermometer. Such plants are not expensive and are very simple in operation.—Dr. Charles H. Herty, in address on "The Turpentine Industry in the Southern States," 1916.

MODERN METHODS. Before going into a discussion of the process of thermometer distillation, some of the causes which influence the quality and quantity of the products of crude pine resin may be mentioned, the most important of these causes being as follows:

1st. The exposure of the gum to atmospheric conditions.

2nd. The amount of dirt, wood particles and other foreign matter in the gum, mixing low grade with high grade gum.

3rd. The coloring matter that is introduced from metal aprons and cups and the chemical action that takes place between the gum and these receptacles.

4th. Distillation.

(a) Heating too fast at time of firing up.

(b) Delaying too long the introduction of water.

(c) Constant fluctuation of the temperature, and corresponding rise and fall of mass in the kettle.

(d) Prolonged heating.

(e) Overheating or carbonizing.

(f) "Holding" charge at too high a temperature.

5th. Handling.

(a) Bad straining through faulty, dirty or torn batting.

(b) Turning into rosin vat that had recently held a charge of lower grade product.

(c) Delaying dipping rosin or dipping at too low a temperature.

These causes may all be eliminated, or the bad effects considerably modified by the practices suggested below and which have been adopted to a large extent in whole or in part by some of the more progressive operators.

I. EXPOSURE. It is essential that gum be exposed as little as possible to the action of sun, air and rain, otherwise there will be a large loss of turpentine from evaporation and the absorption of oxygen will tend to lower the grade of the rosin. This exposure may be overcome to a great extent by having a short "face" (distance between cup and peak) for the gum to run over before being deposited in the cup. To shorten the face, the cup is raised up to or near the peak at least once each year. (If a more practical way can be found, it should be raised more often). The same results can be largely obtained by employing the "jump streak," which gets its name from a method of woods-work whereby at regular intervals of several months or a year, the "chipper"—after putting on a heavy "shade streak"—jumps his hack an inch or two above the peak and starts chipping on up the tree in the new wood. This leaves a belt of uncut wood and bark across the face, and the gum running down from the streaks above reaches this and quickly drops off directly into the cup below,—this saving the exposure and loss that would be the case if it had to slowly flow down the entire face between the old peak and cup As stated, the effect is the same as raising the cup, and when correctly done shows a considerable improvement in both quality and quantity of the crude pine resin.

Gum made during long or heavy rain spells is inferior, as a great deal of the fresh gum is washed away or floated off the cups while that which remains is subjected to excessive exposure,—a large percent. of the volatiles being lost before it will sink in the water that fills the cup. A permanent cover for the cups that would prevent the introduction of foreign matter, reduce the effects of rains and give shade from the sun, has been tried, but so far has proven very costly. However, it is expected that something in this connection will be introduced at an early date.

In all cases, resin should be dipped out as quickly as possible and distilled immediately. It pays to dip at intervals as short as one week or ten days, instead of the usual three to four weeks. The increased quantity of turpentine and better quality of rosin more than offsets the increased cost of gathering. The semi-dried gum (called "scrape") that adheres to the face should be pushed down into the cup frequently, or if this is impossible the face should be thoroughly scraped at least twice a year,—the chipping always continuing up to the week of scraping, and the "scrape" hauled in and distilled quickly. The old idea of gathering the "scrape" crop at the end of the season, is really bad business and will show considerable loss to the producer, as every barrel of "scrape" taken at the end of the year is worth several dollars less than the amount of fresh gum which dried out to make the "scrape,"—and, of course, the cleaner the face can be kept of this drying gum, the smaller the loss will be.

2. FOREIGN MATTER. Pine straw, bark and hack chips that fall into the cup; particles of burned wood, dirt, sand and dust blown in by the wind, or washed in by the rain,—all give up stains that lower the quality of the crude resin. A large percent. of these woody particles can be eliminated by the chipper carrying a wide cup cover that will closely fit the trunk of the tree, allowing no trash to fall from the chipping into the cup or on the apron.

In "scraping" the effort should be to take off no wood at all. The small amount of "scrape" left on the face is insignificant in comparison to the saving in labor and hauling and the fact that when wood is skimmed out of the still it will take off more product than it brings in it,—not to mention the better grade of rosin that can be made from clean "scrape."

Foreign matter in the gum has been one of the causes of greatest losses to the naval stores producer and every means should be used to prevent it. There has been a method developed and apparatus will soon be introduced for filtering the gum before distillation—this will largely eliminate the lowering of grades and the waste of turpentine and rosin from this cause,—but this

should in no way reduce the efforts to keep foreign matter out of the gum in the woods.

3. CUP STAINS. Every operator is familiar with the loss of grades occasioned by old metal cups and aprons. After being in use a short time, the stains from these old cups are very noticeable in the gum, and the rosin grades are correspondingly lower. There is no way to absolutely prevent these stains, although their intensity may be reduced by proper handling. No new cups showing faulty galvanization or other coating should be hung, and cups which show badly stained gum in the woods, should be culled out and replaced. If it is absolutely necessary to hang used metal cups, they should be carefully inspected and only those in the very best condition put up,—and always remember that old aprons lower the quality of gum as badly as old cups. There have been some new coatings developed for treating used metal cups, and several of these have proven quite successful. The wooden paddle should be strictly adhered to in the use of coated metal cups of any kind.

THERMOMETER DISTILLATION. In 1906-07, Dr. Stephen Neal, an inventor and chemist of Cordele, Georgia, started a series of experiments at his own distilleries and those of some of his friends, to determine if proper apparatus could be designed to put the distillation of pine resin on a surer and more scientific basis. His facilities for experimenting were necessarily restricted, nevertheless, he produced a turpentine still thermometer that now bears his name, and discovered some of the necessary temperatures that are now used in the improved method of distillation that is rapidly being adopted by progressive operators everywhere.

The heat control and indicating apparatus has been improved from time to time, and a continuous and careful study made of the processes of distillation. As a result, the quality and quantity of the products obtained from the crude resin are being greatly increased. Improved thermometers are now in general use, and every naval stores manufacturer who has supplied himself with the proper apparatus, made a careful study of the information furnished, and made certain that his employes followed instructions, has very materially increased his profits, or been put on the road to make money where before his operations were a net loss.

The modern method of thermometer distillation as finally perfected produced a much higher percentage of high-grade rosin than was possible with the old methods of sound distillation and greatly increased the amount of turpentine obtaind from the crude resin. There is also quite a saving of fuel and time, and the danger of disastrous fires—so common with the old methods—is almost entirely removed. The former apparatus is still used, but there is better arrangement and addition of improved appliances. The most important of these appliances is the thermometer, a specially constructed instrument that will accurately and positively indicate the exact condition of the operation at every stage.

As all the operations in the distillation of pine resin are governed by temperature,—the "stiller" must be thoroughly familiar with the correct temperature at which to introduce water, the correct temperature at which to "hold" the charge, the correct rate of increasing temperature, and the correct temperature at which to "turn out"—the amount of water and fire being at all times determined by the movement of his thermometer.

The presence of water or steam in the kettle is necessary, otherwise the distillation would have to be carried on at a much higher temperature, to the detriment of the rosin. A mixture of water and turpentine, or water and crude pine resin, boils at a variable temperature slightly under the boiling point of water alone, or about 210 degrees F. As soon as this temperature is reached in the kettle, a mixture of steam and turpentine vapors starts to "come over" and is condensed in the worm. The water and turpentine, after being condensed back into liquid form, immediately separate,—the turpentine being lighter floats on top of the receiving vessel and the water settles to the bottom. There are also some other distillates in minute quantities brought over out of the gum and foreign matter in the kettle that are carried off in the waste-water, or so-called "low wine."

The free water in the gum gives the necessary steam at the beginning of the charge; however, this free water is soon cooked out and the temperature starts to rise rapidly, breaking up the resin and driving out any so-called "adherent" water. In order to continue the distillation without injuring the products, a small continuous stream of water is introduced into the kettle just as the adherent water is being cooked out. If this were not done, the distillation would practically cease until the boiling point of the turpentine is reached (315-320 F.) However, at this high temperature, the turpentine comes over colored and unmerchantable and the rosin also quickly discolors with a corresponding decrease in value. The amount of this discoloration or loss of grade in the rosin depends on the length of time the mass is maintained at too high a temperature,—pale rosins will be quickly affected,—lower grades being of a much darker color to start with are not so easily injured. However, the loss in quality of both the turpentine and rosin is very great under all conditions from distilling at high temperatures, and the "charge" must be carefully handled to prevent this.

The temperature at which the adherent water is given up, called the "water point," varies for each grade of gum,—"virgin gum" breaking up at a low temperature, and "unraised yearling" and "buck" gum at higher temperatures. These temperatures are found to largely depend on the amount of exposure to atmospheric conditions that the gum has undergone,—in other words, the height of "face" (distance between the cup and peak), and the period of dippings; and, of course, trees that run abundantly will give a much fresher gum than others that have a meagre output. The exposure to atmospheric conditions induces evaporation and oxygenation and increases the viscosity and so raises the water point. The correct temperature at which the water should be introduced for each grade of gum, has been carefully worked out and listed for the information of the "stiller."

At the time water is introduced, there should be a good fire under the kettle and the temperature should be allowed to rise steadily for a short time. If sufficient water is being added, it will soon tend to cool off the charge, and the temperature will slowly stop rising. If too much water has been added, the temperature will quickly stop rising and start to fall in spite of a good fire. If not enough water is added, the temperature will continue to rise rapidly, tending to go beyond the "holding point." When the water has been regulated correctly, the temperature will slowly but steadily rise. When the rising temperature slows down too much or stops entirely, it is, of course, time to "fire up" again, after which the temperature will slowly rise a few degrees and stop again and more fire must be added. A balance is thus maintained between the rate the water is being introduced and the rate the heat units are supplied to convert the mixture of water and turpentine in the mass into vapors. The temperature is thus brought up to the "holding point," which has been worked out for each grade of gum. The charge is steadily "held" at this point by watching the thermometer and regulating the fire and water—the distillate coming over in a good steady stream, showing about 50 per cent. turpentine and 50 per cent. water, and, of course, being about double the volume of the stream of water that is being added in the kettle.

The proportion of turpentine in the distillate will remain fairly constant for some time. However, as the amount of turpentine in the mass gradually grows small, this proportion coming over in the distillate slowly decreases. The temperature is now allowed to rise very slowly and when the distillate shows only about 20 per cent. turpentine and 80 per cent. water the fuel is added a little more rapidly and a comparatively rapid rise in the temperature maintained,—until when only about 5 per cent. of turpentine is coming over in the distillate, the thermometer should show about 300 degrees and the charge is ready to "take off." The water is now cut off entirely and the thermometer allowed to rise about 5 degrees. The still is now "uncapped" and the fire

"pulled." The temperature will now quickly rise as the remaining water is converted into steam and the foam on top of the mass will subside and go "flat." The temperature now being about 312 degrees, the tail gate is opened and the mass flows out into the strainers, filtering through these into the rosin vat below.

This process of distillation leaves nothing to guess work and is absolutely certain of producing uniform results of the highest quality and quantity. When a charge is distilled by this process it is impossible for any of the turpentine to remain to be turned out in the rosin and lost. It is also impossible to scorch or lower the quality of the turpentine or grade of the rosin. The rosin will also "strain" easily with the use of the minimum amount of cotton batting and with the minimum loss of rosin adhering to the dross and batting.

The thermometer process of distillation, as easily seen, is very simple and any "stiller" or producer can easily learn how to govern his distillation entirely by the movement of the thermometer after a few days' practice, so that there is no good reason why this process should not be in use at all distilleries, not only increasing the profits of the individual producer, but saving to the industry a very large economic loss.

HANDLING. STRAINING. For properly straining rosins, it is necessary that the temperature be maintained as high as possible without reaching the point of carbonization, at which the grade will begin to lower and the rosin spirits will begin to distill out. For good results, it is desirable to get the rosin on the cotton batting a little above the temperature of 306 degrees and to keep it as near this temperature as possible until completely strained. A cotton batting strainer surface should be provided of at least 6 square feet to the barrel of rosin strained. The strainers should also nest as completely as practical, in order to hold the heat.

The batting should be carefully placed and securely stuck to the sides of the strainers and should be held firmly in place with lengths of heavy iron. It is essential that the sides of the strainers be kept thoroughly scraped so that the batting will have an even surface to adhere to, and that the supporting wire be kept as taut as possible. Unless the batting is of extra good quality, it is better to use two thicknesses.

MIXING. A well distilled charge of pale rosin strained perfectly, may be lowered a grade or more by running it into a wooden vat that has recently held a charge of low grade (red rosin). With the wooden vats it is almost impossible to overcome this trouble entirely as they cannot be thoroughly cleaned.

DIPPING. Rosin should be dipped from the vat into barrels without delay. Hot rosin has the property of absorbing or taking up in some combination, oxygen. This materially lowers the grade of the rosin, and it is necessary that the surface exposed to the air be reduced immediately as much as possible.

BLEACHING. Rosin may be raised several grades by placing it in shallow vessels, and exposing it to the sun and light. Cold rosin does not oxidize, but bleaches up under these conditions. However, in barrelled rosin we profit very little by this fact, as only a few inches on the tops of the barrels are affected, and it takes some ninety days exposure to bleach a barrel up one grade four inches deep,—below this depth no raise in grade is appreciable, even after months of exposure.

TURPENTINE CONDENSING. In the handling of turpentine it is first essential that the worm be kept cool. This not only causes efficient condensation, but prevents the possibility of any back pressure being put on the kettle. This would have the undesirable effect of raising the boiling points, retarding the distillation, causing undue firing and the fluctuation of the volume of the mass in the kettle. As a rule, the temperature of the condenser water should not be allowed to go above 90 degrees, the thermometer bulb being placed in the waste-water pipe.

SEPARATION. The problem of efficient separation of spirits and low wine, preventing the loss of turpentine, or the presence of water in the merchantable product, has been solved by the separator recently placed on the market. This apparatus is made to a scientific exactness, and under all conditions gives perfect separation wthout loss of any kind. It is automatic in action, there are no plugs or valves, and it requires no attention of any kind from the "stiller."

In conclusion it may be stated that as the supply of virgin timber in America for naval stores operation is now very limited and as the end of this supply is easily in sight, it behooves every producer of naval stores to carefully conduct his operations so that there will be a minimum damage to the timber in the woods and at the same time the maximum extraction of crude pine resin from the trees. The advancement in the methods of "woods work" has been remarkable in the past ten years, and the production per tree or per "face" has been considerably increased. However, there is still much room for improvement, especially in saving and in getting to the still in good fresh condition every drop of crude resin that is produced. It must be remembered that it takes 300 trees a long month to produce a fifty-gallon barrel of crude pine resin, and that much expensive work has to be done on the trees both in preparation before and operation during this production. The loss of even a minute quantity of resin per tree will in the aggregate amount to very large figures, especially when it is remembered that the average "turpentine place" is constantly working about 300,000 trees, or about 400,000 cups.

The proper distillation and handling of the crude pine resin and its products after delivery to the distillery is essential and all operators who want to put their business on a substantial basis so that a profit can be made even when the market is comparatively low, are paying a great deal of attention to the distillery and seeing that the best equipment and appliances are installed and properly used,—as they have realized that their loss of money heretofore has been just about the same as the loss in turpentine and grades of rosin from inefficient methods of distillation of their crude pine resin.

WHAT UNCLE SAM DOES FOR THE NAVAL STORES INDUSTRY

(By F. P. Veitch and V. E. Grotlisch, Bureau of Chemistry, U. S. Department of Agriculture, Washington, D. C.)

[Mr. F. P. Veitch received his education at the Maryland State College, with post graduate work at George Washington University, Washington, D. C., specializing in agriculture and in agricultural chemistry. After thirteen years spent in general work in agricultural chemistry he was, in 1904, placed in charge of the work of the Bureau of Chemistry (Washington, D. C.) on naval stores and related materials. He has kept in close touch with naval stores production and, through frequent visits to the woods and stills and to the industries using turpentine and rosins, has, under the Chief of the Bureau of Chemistry, been responsible for the development of the standard glass types for grading rosin, the investigations on which those glass types are based, and for the collection of semi-annual statistics of production and of stocks in the hands of consumers, inaugurated by the Department of Agriculture in 1918. Detailed information of the work of the Bureau of Chemistry in relation to naval stores is given by Mr. Veitch in the following article.]

THE United States Department of Agriculture has been helping the naval stores industry for over twenty years. Both the Forest Service and the Bureau of Chemistry are doing work for the advancement of the industry. The Forest Service is concerned primarily with the production of the raw materials from which naval stores are obtaine by distillation, that is, the woods work, while the Bureau of Chemistry is concerned with the production, transportation and grading of the finished products, such as turpentine, rosin, and other pine products, together with chemical investigations thereon.

Work of the Forest Service.

In 1896, before the introduction into this country of the cup and gutter system, a bulletin entitled "The Timber Pines of the Southern United States" was published by the Division of Forestry (now the Forest Service) of the Department of Agriculture. A detailed description of the methods of producing turpentine and rosin is contained therein, and reference is made to experiments being conducted at that time to determine whether the color of the rosin produced from yearling or third year gum, which was always darker and of a lower grade than virgin rosin, was caused by chemical or physiological differences in the composition of the gum as it exuded from the tree, or was merely due to controllable differences caused by faulty manipulation, careless handling, too infrequent dipping from the boxes, prolonged exposure to the air, and so forth. The results of those investigations showed that the darkening of the rosin was due chiefly to the oxidation of the gum and evaporation of the turpentine during the prolonged exposure to light and air as it slowly trickled down the long face, which on third and fourth year chipping amounted to from four to six feet. It was shown that if the gum were collected in some kind of a raised cup shortly after exudation from the tree, provided the cup were clean and free from rust, high grade rosin and almost as much turpentine could be produced from third-year chipping as from virgin or yearling gum.

Introduction of the Cup System.

At that time also the department began to call attention to the enormous waste and destruction of timber accompanying the production of turpentine by the "box" system then in general use.

In 1901 the Bureau of Forestry retained Dr. Charles H. Herty, who modified and adapted to American conditions the cup system long used in France, (see footnote), to supervise preliminary experiments with the new sys-

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To eulogize the work done by Dr. Charles H. Herty for the turpentine industry is not necessary. It is too well known and esteemed by the industry to render this necessary. But it is not amiss to reproduce, with consent, a portion of an article on "The South Realizing Itself," by Edwin Mims, Professor of English in the University of North Carolina, appearing in the "World's Work" for December, 1911. Said Dr. Mims: Professor C. H. Herty (then head of the department of chemistry in the University of North Carolina) while taking lectures at Charlottenburg, Berlin, under Professor O. N. Witt, one of the most celebrated industrial chemists of Europe, inquired of the professor one day what he thought of the turpentine industry of America. With a characteristic German gesture the latter threw up his hands and exclaimed: "You have no industry, you have a butchery. I speak from personal knowledge, for I have been in Florida. You are wasting your natural resources and get nothing like an adequate return from them." The remark was a surprise to the young American scholar, who had been born on the edge of the turpentine belt and had heard all his life of the money made from the industry. He could make no reply at the time, having never seen the actual operation of getting resin from the pine trees. He decided that as soon as he reached home he would see for himself, and, if the criticism proved true, devote himself to finding a remedy. He began his investigations at Valdosta, Ga. He saw at a glance the wastefulness of the method employed. In addition to the necessary "wounding" of the tree to cause the resin to flow, deep holes, "boxes," were cut at the base. These boxes weakened the trees so that they were an easy prey to winds and forest tree fires. Moreover, there was a good deal of waste in dipping the resin from the boxes. Such was the practice which he saw, a practice that was not very efficient in getting resin and which was very destructive to the forests. He secured all the literature on the subject and found that in France the turpentine operators had used clay cups instead of boxes cut in the wood, and that in this way the trees had been saved for as much as a hundred years. He found, too, that many patents had been procured at Washington by men who had worked at the problem of substitutes for the harmful box method. The difficulty with the French method was that it called for skilled laborers that could not be commanded in the South; and the difficulty with the American patents was that none of them had been successful commercially. So he went to work to find a substitute that would be simple enough to be used by the negro laborers, cheap enough to command the attention of operators and renters, and efficient enough to secure a maximum flow of resin. On his first vacation, (he was then adjunct professor to the University of Georgia), he went to Savannah to interest the turpentine men in his ideas and plans. He met with almost entire indifference on the part of men who seemed to feel that it was better to leave good enough alone, especially as pine forests seemed almost inexhaustible. At the end of his second day, after almost abandoning hope, he secured a promise of some timber with which to experiment and a pledge of $150 to cover actual expenses. In the spring of 1901 he fitted up near Statesboro a sort of forest laboratory, arranged in various plots of timber to test the comparative results of the box and cup methods. He found it difficult to get laborers, the negroes having nothing but contempt for the "flower pots" that were put upon the trees, for his system consisted of little metal gutters running diagonally down across the facing and emptying into a cup, an earthenware pot hung on the side of the tree. It was a very simple looking thing to revolutionize a great industry. One man was not indifferent to the results of these investigations. Mr. Gifford Pinchot, then in the forestry department at Washington, after hearing Professor Herty's story, said: "You are the man I have been looking for. What can we do? We will publish anything you write. You'd better become one of the experts of the department. This means not only increased profits for the turpentine operators, but the conservation of our forests." The result was that Dr. Herty resigned his professorship and, with the support of the Bureau of Forestry, conducted experiments on a much larger tract of timber at Ocilla, Ga.—the owners of the tract furnishing labor and timber and getting the profits. There, with a squad of twelve negroes, by systematic tests, he proved still more conclusively that an increased yield over a longer period of time and a better quality of resin came from the cup method than from the old boxes. Three years later similar tests showed an increased yield of 30 per cent. in the "cuppings" of the second and third years, while at the same time the trees were preserved from storm and fire. The next problem was to get the cups. As the result of an address made at Jacksonville in 1902 before the Association of Turpentine Operators, which had been organized two years before to limit the output of turpentine in order to save the forests, Dr. Herty aroused widespread interest in the new method. The newspapers were his enthusiastic supporters. The railroads became interested to the point of giving a greatly reduced rate on the transportation of the cups, while some owners of timber lands pledged themselves to let their lands only on condition that the operators should use cups.

tem on the turpentine farm of McDougald and Company, of Statesboro, Ga. The results of the small scale expen ments, in which comparative studies were made on first, second, third, and fourth year boxes in sets of 100 each (50 boxes and 50 of the new cups) were so promising that the next year the experiments were continued on a larger scale. On the turpentine farm of Powell, Bullard and Company at Ocilla, Ga., an entire crop each of virgin, yearling, third-year, and fourthyear boxes were selected so as to represent the average stand of timber. Half of each crop was fitted with the new cups and gutters and the other half of each crop worked in the regular old "box" way. The results showed beyond doubt that the cup system was far superior to the box system with respect to yield of turpentine and rosin, grades, financial return, as well as in preventing loss of timber due to wind fall, dry face, death of trees, and other causes.

Conservation of Timber.

Certain developments of these first experiments led to the continuation of the experimental work on timber furnished by the Walkil Turpentine Company, of Walkil, Fla. The results of this work showed that the depth of chipping then commonly practiced, approximately three-fourths of an inch, could be materially decreased (to one-half inch) without diminishing the total yield of turpentine and rosin at the end of a four-year period, and at the same time the ..ees would be left in a far more vigorous condition with a smaller percentage of dead trees and dry faces. Two other points were brought out. In the first place, the yield of gum over a period of four years is as great or greater when the amount of wood taken off with each streak is reduced by one-third with the depth of chipping remaining the same as ordinarily practiced. Secondly, the adoption of a policy of not turpentining any trees less than ten inches in diameter, with not more than one cup on a tree up to 16 inches in diameter, and not more than two cups[1] on any tree above that size, not only conserves the forests for re-turpentining, with a minimum loss of timber due to death from the first turpentining operations, but also increases the financial returns. The tapping of any tree less than ten inches in diameter is done only at a loss to the operator, no matter what the market prices of turpentine and rosin may be.

New Sources of Turpentine.

In a Forest Service bulletin entitled "Possibilities of Western Pines as a Source of Naval Stores," published in 1912, it was shown that the Western yellow pine growing in Arizona and California yields gum in paying quantities,

1 The limit of two cups to any tree above 16 inches in diameter is, of course, based on the size of the timber which is common in Georgia and Florida. On the large timber found in the western part of the turpentine belt, the number of cups hung on the larger trees is often increased to three.

A Cup Used in the Experimental Work of 1902.

and although it may not be possible or profitable to produce turpentine there in competition with the industry in the Southern states, nevertheless at the present rate of diminution of the supply of Southern long leaf yellow pine the day may not be far distant when the vast tracts of Western yellow pine will have to be tapped to supply the demand for turpentine. There is at least one still operating on a commercial basis in California on Western yellow pine at the present time.

Practically every species of pine tree growing in large uniform tracts has been examined and the gum therefrom tested to ascertain its suitability as a source of turpentine. The results of these investigations were published in a bulletin issued by the Forest Service in 1913, entitled "An Examination of the Oleoresins of Some Western Pines," followed by a series of articles in the Journal of Industrial and Engineering Chemistry. Among the various pine oleoresins examined were those from the following species: Western yellow pine of two different but closely related varieties, digger pine, sugar pine, lodgepole pine, pinon pine, sand pine, and Jeffrey pine. The results of these investigations showed that the sugar pine, the digger pine, and the Western yellow pines are the only ones which yield volatile oils possessing any real similarity in composition and properties to Southern yellow pine turpentine. The yield of gum from the sugar pine was so relatively small, however, that it is hardly probable that this species will ever be used for producing spirits of turpentine on a commercial scale.

These oils, although having initial distilling temperatures similar to that of long leaf yellow pine turpentine, contain larger percentages of high-boiling constituents than are normally present in turpentine, and consequently did not distil to the required extent within the limits set in present specifications for commercial spirits of turpentine. It would probably require a somewhat longer time for complete evaporation, and a paint or varnish containing such oils would dry somewhat more slowly. This, however, is not always a disadvantage, and for use where rapidity of evaporation or drying is not essential, such oils could readily replace long leaf yellow pine turpentine. However, if quick drying oils were desired, these could be easily prepared from the above oils by a simple process of fractional distillation, and commercial uses could undoubtedly be found for the high boiling portions.

Production of Naval Stores.

In 1915 a Forest Service bulletin entitled "The Naval Stores Industry," was published, giving a fairly complete and very interesting resume of the naval stores industry, with a summary of the results of the various experiments which had been conducted up to that time. It includes interesting articles on such topics as the history of the industry in the United States, the formation and flow of resin in the living tree, the principles underlying the distillation of crude gum, and a description of the methods of working the trees and distillation of the gum as practiced in the pine forests of France.

In 1917 a bulletin entitled "Increased Yield of Turpentine and Rosin from Double Chipping" was issued, giving the results of experiments carried out on a tract of timber at Columbia, Miss., in which it was shown that by double chipping, that is, chipping twice a week during the warm summer season, and taking off only half as much wood as is the usual custom (going up the tree one-fourth inch instead of one-half inch per streak) with the usual depth of one-half to three-fourths inch, the yield from virgin timber was considerably increased, both of turpentine and rosin, as compared to ordinary chipping operations (three-fourths inch deep and one-half inch up the tree per streak). The height of the face at the end of the season was approximately the same in both cases.

The Forest Service constantly strives to assist the industry, urging greater care of the timber and better woods work. Operators should keep in touch with this branch of the Department of Agriculture and its investigations along these lines.

Work of the Bureau of Chemistry.

Prior to 1912 much of the turpentine coming on the market was adulterated, principally with kerosene or mineral spirits. The honest producer or dealer was either placed at a decided disadvantage in the market by his unscrupulous neighbor who was selling kerosene for turpentine, or else had to become dishonest, too. Although numerous methods of detecting and determining adulteration had been published, they

Looking Through the Comparison Box to Compare a Sample Cube of Rosin with a Standard Type, Both Attached to the End of Box.

were all more or less cumbersome, and in general unreliable for determining small percentages of adulterant. After some research, a method, or rather a modification of an older method, was devised. This method not only gives reliable results for small quantities of adulterants (as low as one to two per cent.), but is also rapid and easy to manipulate in the laboratory. It is described in Bureau of Chemistry Bulletin 135, entitled "Commercial Turpentines, Their Quality and Methods for Their Examination," published in 1911. The results of the examination and comparative study of a large number of turpentine samples from various sources and produced by different processes, many of which were collected from paint, drug and general merchandise dealers throughout the country, are given in this bulletin, together with recommendations for specifications for turpentine based on the results obtained on the large number of authentic pure samples examined. It also contains a description of the systematic examination of turpentine as carried out in the laboratory to determine compliance with specifications and purity. The method of detecting and determining the extent of adulteration of turpentine with mineral oil was also published separately in Bureau of Chemistry Circular 85.

The results of these investigations, as made public, served to call the attention of users of turpentine to the extent of adulteration being practiced, and helped largely in bringing about a material decrease in the promiscuous adulteration of turpentine. The producer was benefited by decreasing the fraudulent use of adulterants and the consumer of turpentine by helping him to get pure turpentine for his use.

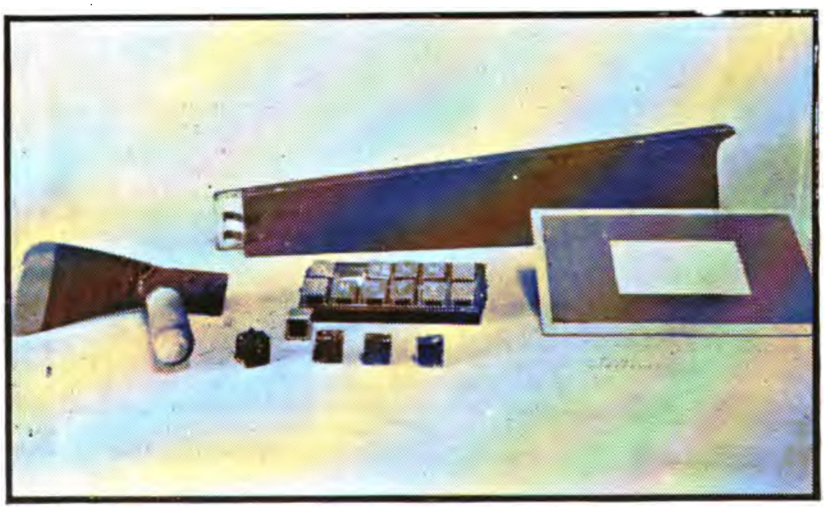
The Bureau of Chemistry also examines turpentine sold for medicinal purposes which is shipped in interstate commerce, as the adulteration and misbranding of such turpentine constitutes a violation of the Federal Food and Drugs Act. Court proceedings are instituted in such cases.

In 1911 and 1913 both the Bureau of Chemistry and Forest Service issued bulletins on the wood turpentine industry, which at that time was in its early stage of development. Methods of refining wood turpentine were given in these publications.

Permanent Glass Types for Rosin.

Since 1912 the Bureau of Chemistry has been turning its attention to the transportation, grading, handling, and uses of naval stores. Prior to that time accurate and permanent standards for the various grades of naval stores, such as rosin and turpentine, were lacking. A large number of sets of rosin types then in use were collected and measurements made of the colors of the various grades, which, needless to say, varied widely, in some cases as much as two grades between different samples supposed to be of the same grade. After investigating the fastness to light of different materials which suggested themselves as being suitable for rosin standards, a certain kind of glass produced in England was chosen. This is known as the Lovibond Tintometer glass, and is used for preparing standards for measuring colors of other materials, such as syrups and oil. Since the color transmitted by a cube of rosin is primarily a mixture of yellow and red, the Government glass standards are composed of slips of yellow and red glasses, securely fastened in a nickel plated glass casing.

A set of these glass types, which were made to equal the average color reading of a large number of commercial sets of rosin type samples, is kept in the Bureau of Chemistry at Washington, and a number of prototypes of these glass standards, made to exactly match them, have been completed and issued



One of the Bureau of Chemistry's Standard Outfits for Determining the Grade of Rosin. At the Left is the Adz. In the Foreground Are Sample Cubes of Rosin. Eleven of the Twelve Standard Types Are Shown in Their Cases. The Comparison Box Is at the Rear and the Translucent Screen at the Right.

to the following centers of the industry, as outlined below:

Bureau of Chemistry, United States Department of Agriculture, Washington, D. C.

Supervising Inspector of Naval Stores, Board of Trade, Savannah, Ga.

Supervising Inspector of Naval Stores, Jacksonville, Fla.

Board of Trade, Brunswick, Ga.

Chamber of Commerce, Mobile, Ala.

Turpentine and Rosin Producers Association, New Orleans, La.

Supervising Inspector of Naval Stores, Produce Exchange, New York, N. Y.

United States Food and Drug Inspection Laboratory, Boston, Mass.

United States Food and Drug Inspection Laboratory, Chicago, Ills.

United States Food and Drug Inspection Laboratory, San Francisco, Cal.

Chamber of Commerce, Philadelphia, Pa.

Chamber of Commerce, Cleveland, O.

Detroit Oil, Paint and Varnish Club, Detroit, Mich.

Chairman, Naval Stores Committee, National Paint, Oil and Varnish Association, care I. Winkler and Bro. Company, Cincinnati, O.

London Oil and Tallow Trades Association, London, England.

Directions for using the types and the grading equipment accompanying each set, and a rosin sampling adz is included in the equipment at many places.

The war seriously hampered deliveries of the glasses from England, so that it has been impossible to prepare these types in sufficient quantity for sale to individuals. The Bureau of Chemistry hopes, however, to have ready in the near future some fifteen or twenty additional sets to be deposited with the larger consumers and at other centers of consumption.

Turpentine Standards.

The grade samples of turpentine were likewise without a definite standard. It is a well known fact that turpentine often changes in color very rapidly when exposed to the light, some samples becoming lighter in color and others darker. After comparing and measuring the color of a large number of grade type samples, with repeated attempts to find some substance or solution which could be used as a standard, it was finally found necessary to define the grades of turpentine in terms of a No. 1 yellow Lovibond tintometer glass. No solution or liquid has so far been found which will give a satisfactory color match for turpentine and still retain its color permanently at the dilution necessary to match the color of turpentine. A promising solution of this problem is now under investigation.

The various grades of turpentine, water white, standard, one shade off, and two shades off, are defined as follows:

Water white—Requires a depth of 150 millimeters (5 7-8 inches) or more to equal in color the No. 1 yellow Lovibond glass.

Standard—Requires a depth of 50 to 150 mm. to equal the No. 1 yellow Lovibond glass.

One Shade Off—Requires a depth of 25 to 50 mm. to equal the No. 1 yellow Lovibond glass.

Two Shades Off—Requires a depth of 15 to 25 mm. to equal the No. 1 yellow Lovibond glass.

Demonstration Work.

Since 1915 the Bureau of Chemistry has been conducting demonstration work on naval stores, sending agents into the field during the producing season to suggest, explain, and demonstrate simple improvements in methods or equipment used at the turpentine stills, which will give better yields of turpentine and rosin by decreasing the loss by waste, improving the grades of rosin obtained and correspondingly reduce the cost of production. Many stills throughout Georgia, Florida, Alabama, Mississippi, Louisiana and Texas have been visited, and this work is being continued.

In addition, posters and circular letters bearing on various phases of the naval stores industry, urging the prevention of needless loss through wastefulness and carelessness in handling of the gum, stilling, and treatment of the finished products, have been sent to all operators.

The Bureau of Chemistry is always glad to help the producer solve his difficulties. A statement of any particular problem of this kind addressed to the Bureau of Chemistry, U. S. Department of Agriculture, Washington, D. C., will receive prompt and careful attention.

At the request of both producers and consumers the Bureau in 1918 inaugurated the collection and publication of statistics on production of naval stores, stocks on hand at the stills, at the ports, and in the hands of dealers and jobbers, and in the hands of the chief consuming industries of the country. This information is collected by direct reports from individual consumers, and by actual count of the stocks on the storage yards by Bureau agents. Individual production or stocks are not reported, only the total production and total stocks in the possession of producers, consumers and on the storage yards being made public. The following reports have been issued:

1. Production, season of 1918, to August 1, with stocks on hand at the stills on that date, and estimated production for the entire season.
2. Total production, 1918, with stocks at stills on March 31, 1919.
3. Stocks of turpentine and rosin on storage and jobbers' yards and in hands of chief consuming industries on March 31, 1919.
4. Production, season of 1919, to August 1, with stocks on hand at the stills on that date, and estimated production for the entire season; also stocks in hands of chief consuming industries on August 1, 1919.
5. Stocks on storage yards and in hands of dealers and jobbers on February 2, 1920.
6. Total production, season of 1919, with stocks at the stills and in hands of chief consuming industries on February 2, 1920.

Any of these reports may be had free of charge by addressing a request to the Bureau of Chemistry.

The Government Departments frequently buy turpentine in large quantities. In order to make the request for bids and the filling of requisitions more simple and uniform, an inter-departmental committee has drawn up and adopted uniform specifications for turpentine which embody the latest information available on turpentine from all American sources. These have been adopted by practically all purchasers of turpentine. The Bureau of Chemistry furnished most of the data on which these specifications are based and took the active part in formulating them. They have been published by the Inter-Departmental Committee on Paint Specification Standardization, as Circular 86 of the Bureau of Standards, U. S. Department of Commerce. The Bureau of Standards has also published data of scientific interest on the expansion of turpentine for changes in temperature. These data are of importance to shippers of turpentine in bulk.

Information Supplied by U. S. Department of Commerce.

The Bureau of Foreign and Domestic Commerce of the U. S. Department of Commerce, issues a monthly summary on our foreign commerce, which includes the exports of turpentine and rosin, itemized as to the countries of destination, with the corresponding exports for the same month of the previous year. It also gives the total exports of naval stores to the various countries for the calendar year up to the month of issue of the summary, with the corresponding figures for the two preceding years. At the end of the year this information is summarized to cover the entire year and is somewhat more specifically itemized as to the countries of destination of the exported products. It also gives the quantities exported from each of the various customs districts into which the country is divided.

The Census Bureau, U. S. Department of Commerce, collects and publishes statistics on manufactured products every five years. Turpentine, rosin and other wood distillation products are included under the general heading "Chemicals and Allied Products." The information given by the Census Bureau includes, besides the total production of gum spirits and gum rosin, also the wood turpentine, wood rosin, dross and other products, with the total value of each.

Finally, the State Department, through its consular agents, collects information on production, stocks, and uses of turpentine and rosin in foreign countries, which information is published by the Department of Commerce.

FOREST SERVICE INVESTIGATIONS OF INTEREST TO THE NAVAL STORES INDUSTRY

(By L. F. Hawley.)

[In charge Section of Derived Products, Forest Products Laboratory, Madison, Wisconsin.]

SOME of the earliest experimental forestry work of the Department of Agriculture dealt with subjects of great importance to the naval stores industry. Circular No. 8 of the old Division of Forestry (undated) made a preliminary announcement of experimental work on the strength of turpentined and unturpentined timber; and Bulletin No. 8, issued in 1893, gave the details of these tests, in which it was shown that there was no noticeable difference in the strength of unturpentined timber, recently boxed timber, and timber turpentined and abandoned for five years. It is curious that, although this information was widely published at the time and has been frequently mentioned since, there are still a few pople who believe that turpentining affects the strength and lasting qualities of the wood. It seems difficult to get away from the notion that by tapping the gum is drained from a reservoir in the tree and that, therefore, the wood of the turpentined tree must be less resinous, less strong, and less resistant to decay.

In Bulletin No. 8 it was also shown that the resin content of turpentined timber was not less than that of unturpentined, with interesting figures on the resin content of different portions of the wood from pith to outer sapwood. That the sapwood always contains much less resin than the heartwood was clearly demonstrated; but it still requires some explanation to show how this can be true, because it is well known that the gum comes only from the sapwood.

These first mechanical and chemical investigations by the predecessor of the present Forest Service seem of almost historical interest now, and their general conclusions are correct, although we may criticise the details of the methods used. In 1897 there followed a comprehensive publication on "The Timber Pines of the Southern United States." In the discussion of longleaf and slash pines a brief description of the naval stores industry of that time was given. It is interesting to note that there seemed to be some doubt whether the Florida pines were quite as suitable for turpentining as such of the Carolina pines as had not been exhausted.

No further publications on this subject were issued until that epoch-making Bulletin No. 40 on "A New Method of Turpentine Orcharding" appeared in 1903. This did what so many publications promise to do but can not fulfill, it "revolutionized the industry." In

Light Chipping. Second Year of Operation. Note Relatively Slight Wound on Tree.

Scene of Experiments on Western Yellow Pine in Arizona.

Typical Western Yellow Pine Turpentine Area in California.

the seventeen years since the appearance of this publication, the use of cups in place of boxes has become almost universal. Another revolutionizing publication appeared in 1911 (Bulletin No. 90) entitled, "Relation of Light Chipping to the Commercial Yield of Naval Stores." Light chipping has been standard practice for several years, and some progressive operators who knew of the experimental results before the publication appeared had already practiced light chipping before 1911.

In 1912 and 1913 the first bulletins on the wood turpentine industry were issued; by this time the production of wood turpentine had become important, the other products of the distillation (pine oil, tar oil, tar, etc.) were becoming better known, and the process seemed to be a promising one for utilizing waste pinewood. Bulletin No. 105, "Wood Turpentines," described the composition and properties of the crude and refined turpentines from various distillation processes and gave directions for proper refining methods. Bulletin No. 109, "Steam Distillation of Resinous Wood," reported experimental results from which most efficient conditions of pressure, speed, and size of chip were developed for producing steam-distilled wood turpentine.

About the same time a very complete study was made of the amount and the composition of the gum from several of the more important Western conifers. "Possibilities of Western Pines as a Source of Naval Stores" was published in 1912, and "An Examination of the Oleoresin of Some Western Pines" in 1913. These publications showed that probably only one species, Western yellow pine, might prove suitable for the production of turpentine and rosin on a commercial scale. In certain parts of its range, particularly in the hottest portions, this tree will yield per face per week about as much gum as longleaf pine ,but the season is likely to be several weeks shorter than in the East. In composition the Western turpentine is slightly different from the standard, having some higher boiling constituents; but it could probably be used for the same purposes. Commercial production of naval stores from Western yellow pine has not yet been reported; but there is said to be much interest in the question on account of the prevail-

ing high prices of turpentine and rosin, and some production may take place during the present season. (See foot note.)

A general descriptive bulletin bringing all these subjects up to date was issued in 1915 (Bulletin No. 229, "The Naval Stores Industry"). A few other reports of interest to the naval stores industry have been made by the Forest Service in technical journals, rather than in Government bulletins, perhaps the most interesting being "A Study of Authentic Samples of Gum Turpentine," Journal of Engineering and Industrial Chemistry, July, 1914. This showed that most of the variation in composition of samples of gum turpentine which had been recorded in the literature on the subject had been apparently due to "ageing" or oxidizing, and that the variation in fresh commercial samples was not very marked. This study also indicated that the greatest effect of ageing was shown by small samples in one to five-gallon cans, and that the ageing during commercial storage in barrels and tanks was very slow.

Typical Western Yellow Pine Turpentine Area in Colorado.

Forest Service methods for crude gum production and collection have been developed to a point where they seem fairly satisfactory for the conditions under which they were used, but the rapidly changing conditions of the industry will soon require new methods to meet new conditions. It may even be necessary to develop a method of chipping which will give a maximum average yield over ten to fifteen years instead of three to five years, and on young second-growth timber instead of large virgin timber. Some unpublished work on turpentining experiments and on the difficult questions of where, how, and possibly why, the gum forms in the tree, together with the results of the work of the Florida National Forest described elsewhere in this book, have led to plans for further work on chipping methods which it is hoped may be carried out next season. Although the results may not be so revolutionary as some which have been obtained in the past, it is hoped that interesting and valuable information may be obtained.

The report of the Forest Service on "Western Pines as a Source of Naval Stores" (1912), states that the average yield of dip from four crops of 8,000 cups each in Arizona was 65,267 pounds, or 0.263 pounds per cup per week. This makes the yield from the Western yellow pine 82.5 per cent. of that obtained from Southern yellow pine. In making this comparison the same unit of time is used in both cases, that is the flow per cup per week. In order that the yield per crop from Arizona and Florida may be on a comparable basis the Arizona yield of 7,817.5 pounds from 1,500 cups may be expressed as the equivalent of a crop of 8,000 cups, or 41,700 pounds. This is 64 per cent. of the average yield secured in the Florida experiments during the season 1905. In the Arizona experiments the first chipping was done May 8 and the last dipping made October 31. Had the cups arrived earlier they could have been hung in April and the season lengthened to 26 weeks instead of 24. The total yield of 1,126.75 pounds of scrape from 1,500 faces is equivalent to a yield of 6014 pounds of scrape from a crop of 8,000 faces. The weight of scrape obtained in the Florida experiments averages 8,338 pounds per crop of 8,000 faces. The yield from Western yellow pine is therefore 72 per cent. of that obtained from Southern yellow pine when the comparison is made on the basis of the whole season.

In the experiments on the Western yellow pine in California the average yield of gum per cup per week, 0.281 pounds, was slightly greater than that in the Florida experiment (0.263 lbs.). The California experiments were not begun until July and had they been started earlier in the season this average might have been lower. Seventeen faces were chipped at monthly intervals during December, January and February. A yield of 16 pounds of dip was obtained, which shows that gum continues to flow throughout the winter in California. There was an equivalent to a yield of 0.018 pounds of scrape per week, somewhat less than that obtained in the Florida experiments. The proportion of turpentine in the California gum is less than in the Arizona gum. The California Western yellow pine shows a considerably smaller proportion of pinene than ordinary turpentine, and contains another oil not found in ordinary turpentine. It is, however, probable that turpentine from California Western yellow pine will prove of commercial value. Its use is recorded in California at the close of the Civil War, when turpentine operations in the Southeast were practically at a standstill. The operations in California were very crude, however, and were discontinued as soon as naval stores from the Southeast became available.

The Arizona experiments show a yield of resin from Western yellow pine (Pinus ponderosa scopulorum) about four-fifths as great as that obtained from Southern yellow pine (Pinus palustris and Pinus heterophylla) in average operation in Florida if the comparison is based on the same period of time for both. Weather conditions in Arizona, however, will allow only a 24 or possibly a 26 weeks' season as against a 30 or 35 weeks' season in the Southeast, so that when the yields for an entire season are compared Western yellow pine shows a production about two-thirds as great as that from the Southern yellow pine. The average proportions of rosin and turpentine in the gum were about the same as in gum from the Southeastern pines, and the turpentine had a composition much like that from the Southeast. The Pinon (Pinus edulis) in Colorado had a rate of flow slightly over half of that of the Florida pines for a 20-weeks' period, from June 9 to October 31. The volatile oil from the pinon gum differs somewhat from ordinary turpentine, but is probably suited to industrial use. The number of cups that can be hung on an acre of average Western yellow pine compares favorably with many areas that are now being turpentined in the Southeast. The Western trees are larger than most of the Southeastern ones. The bark of the Western pines is, however, thicker and rougher, and it will be necessary to remove the outer bark before hanging cups or chipping the trees; and this, of course, means the expense of an extra step not necessary in Southeastern operations. The commercial success of turpentine operations in the Southwest will be doubtful until they have been tried on a commercial scale. Nearly as much turpentine and rosin was obtained from Western yellow pine, and the amount of timber available for turpentine operations in the Southeast is constantly diminishing. These two facts make it reasonable to suppose that turpentine operations in the large tracts of virgin pine timber in the West will, in time, be justified.

RECLAMATION OF ROSIN FROM DROSS

(By George B. Levey, Jacksonville, Fla.)

[Mr. George B. Levey is well known to naval stores producers and the trade through his connection with the Jacksonville Rosin Company, recoverers of rosins from dross, and through his long connection with that branch of the industry has become a recognized expert. For some time he has traveled through the belt buying dross from the operators. He has been an active factor in developing the process to its present high state of efficiency.]

ONE familiar with turpentining knows that new rosin is generally strained through three strainers. A top strainer of coarse wire catches the chips, a middle strainer of fine copper wire catches the finer dirt, and a bottom strainer containing a sheet of cotton batting catches whatever dirt escapes the first two strainers. Naturally a substantial portion of hot resin adheres to the refuse and cotton in the various strainers. This substance from the bottom strainer is known as batting dross, and from the middle strainer as strainer dross. Batting dross has twice the value of strainer dross as it saturates twice as much rosin. Rich batting dross contains approximately 60 per cent. rosin, net weight.

Undoubtedly many active operators can well recall the day when their dross was hauled off and burnt. Today especially adapted refineries purchase this dross from which the rosin is recovered. Fifteen years ago rich batting dross could be purchased for $5.00 per ton in almost unlimited quantities—five years ago at $10.00 per ton, -and today at $50.00 per ton and upwards. Present dross prices range according to its richness and according to the rosin market.

The recovery of rosin from this waste product originated by boiling batting dross in open syrup kettles. As it melted it was dipped off and strained through a wire. This crude method produces an undesirable grade of black rosin generally refused by present day buyers. Following this method came unsuccessful experiments along the retort line both with direct heat and with super-heated steam. These efforts all failed to become paying propositions because approximately only 50 per cent. of the actual rosin could be recovered.

The present day process of recovery by solving the rosin dates back about sixteen years, and has advanced to such a degree of perfection that the rosin and refuse are effectually and entirely separated. The rosin is barreled, the dirt hauled off, and the cotton cleaned and baled.

A solving plant is of the retort type, consisting of several retorts, each holding large quantities of dross. Gasoline, the speediest and most satisfactory solvent, is pumped in with the dross and allowed to stand until it becomes rich with the solved rosin, when it is strained and transferred to the still. Steam heat is applied, vaporizing the gasoline and leaving the rosin. The vapor is condensed for re-use, and the rosin is run direct from the still to the barrels. Rosin so recovered ranges in grade from E to I, and can be used practically wherever gum rosin is used.

The industry has so grown that it consumes all dross made. Refineries are located in all naval stores production centers. It is conservatively estimated that the rosin recovered from dross for the season 1919-20 approximated 40,000 round barrels—representing a heretofore waste product.

———

A few years ago the Bureau of Chemistry furnished the following information relative to the dross rosin:

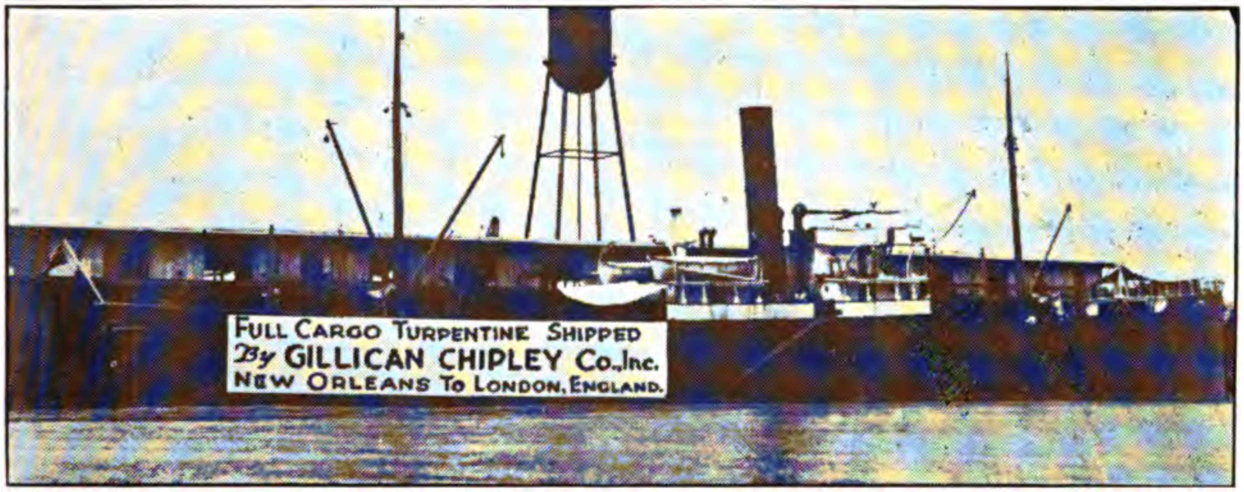
Investigations show that the amount of rosin batting dross obtained per crop, depends almost entirely on three factors. These are, first, the yield of turpentine and rosin per crop, the relative size of the still and strainer, and the number of layers of batting used for straining the rosin. It will readily be seen that a crop of cups yielding 70 barrels of turpentine will produce more dross than a 40-barrel crop, because the amount of gum stilled is vastly greater in the former case. The amount of dross obtained per charge depends partly on the amount of cotton the rosin is strained through. Therefore, two layers of cotton make more dross than one, and, since a large strainer requires more cotton than a small one, it can readily be seen that the size of the strainer also plays a part. It must not be taken from this that a small strainer has an advantage over the larger one. The advantage lies more in the use of a large size still. The size of the strainer needed for a 30 barrel still is not much larger than that used for a 20 barrel still, while the amount of rosin produced per charge can be about fifty per cent. more with the larger size still. Then again, it has been shown that clean gum, free from dirt and trash, will produce clean rosin, with only one layer of cotton, while dirty trashy gum invariably requires two layers of cotton or at least replacement with a fresh piece of half of the first layer of cotton, after it has become clogged with dirt. It is therefore, a decided advantage, from this point of view alone, to have the chippers carry paddles and get clean gum into the still. On average economical operations the data compiled by the Bureau of Chemistry indicates that about one barrel of dross is obtained to every ten barrels of turpentine, or one barrel of dross to every thirty-five round barrels of rosin, on an entire season's operation. About two and three-quarters (2¾) pounds of dross are obtained to every one hundred (100) pounds of rosin produced.

THE NAVAL STORES PORTS OF THE GULF

NEW ORLEANS--MOBILE--PENSACOLA

(By J. A. Myers.)

[Mr. J. A. Myers' connection with the naval stores trade began in 1910 in the domestic department of the American Naval Stores Co. He worked in every branch of the business, including foreign department, auditing department and sales department. He was also located in Jacksonville on the storage yard of the National Transportation & Terminal Company, which was then a subsidiary of the American Naval Stores Company. After the liquidation of the American Naval Stores Company Mr. Myers was manager of the Western department of the Standard Naval Stores Company. After the liquidation of that concern he was sales manager of the National Rosin Oil & Size Company and when their general offices were moved to New York was made general manager of that concern, and also made a trip to Europe in the interest of the company. In 1917 to 1919 he was in the army and after his discharge became sales manager of the Gillican-Chipley Co., Inc., and then vice-president and general manager of the Sales Department, Gillican-Chipley Co., Inc.



British S. S. Rochelle Taking on Full Cargo of Spirits Turpentine at New Orleans.

NEW ORLEANS, located on the Mississippi river, with forty-one miles of harbor front, served by seven big railroads and several smaller ones, offers unexcelled facilities for handling export trade for naval stores as well as that of other commodities. These facilities are publicly owned and operated without profit. The management of port facilities has been assigned to the Board of Commissioners of the Port of New Orleans, otherwise known as the Dock Board. In order to facilitate the interchange of freight from one road to another, a Municipal Belt Railroad, comprising seventy miles of track with connections reaching all rail and river terminals, has been established. There are seven miles of publicly owned steel receiving and discharging harbor front docks, fronting water of many times the necessary depth to receive any vessel afloat.

The development on the west side of the river is being started and offers great opportunity. The western roads such as the Southern Pacific, Frisco, Texas and Pacific, etc., have terminals on the west side as well as those in the city. Transfers are made by barges.

New Orleans, while possessing no special facilities or equipment for handling naval stores, has five storage yards with considerable capacity, on which large stocks of both rosin and turpentine are carried. The Gillican-Chipley Company alone has storage capacity for approximately one million gallons of turpentine, located at their Security Warehouse. This yard is equipped with all modern appliances for barreling and preparing case goods for export trade. Within the last eighteen months this practical method of exporting has been developed by leaps and bounds and the red label of the "Premier Brand" of turpentine is rapidly becoming recognized in all points of the globe. Both the can and the case are made in New Orleans and delivered direct from factory to the yard. Cases are strongly strapped to withstand the many handlings received during export. The London-Savannah Naval Stores Company operates a well equipped yard, through "The Naval Stores Warehouse and Storage Company," which issues negotiable warehouse receipts at both New Orleans and Pensacola.

New Orleans has acquired the term "Second Port" through the immense volume of trade brought by the many boats operating in and out of the port, both on regular lines and on special trips. Fifty-seven steamship lines give New Orleans direct connection with all the leading ports of the world. Twenty-nine of these lines have been established since the war. This does not include the lines that operate ships to New Orleans on irregular schedule, nor does it include the many tramp ships that use this port.

The new lines connect with Antwerp, Rotterdam, Scandinavian ports, Genoa, Trieste, Bremen, Hamburg, Barcelona, Japan, China, Columbia, the Philippines, Chile and Peru, Ecuador, Central America, Mexico, West Indies, Windward Islands, Argentina, Brazil, Cuba and Australia. In addition, New Orleans is seeking liner service to the Levant, South Africa, Dutch East Indies and British India. The tonnage domiciled at this port totals 6,611,078. With this immense volume it can readily be appreciated how it is possible to render service to all ports, and to develop the

Loading Steel Drums at New Orleans, Each Containing 55 Gallons of Spirits Turpentine.

world-wide trade in naval stores New Orleans now enjoys.

On an average, approximately 200,000 barrels of spirits and 650,000 barrels of rosin are produced annually in that territory which is tributary to New Orleans. A considerable quantity of this production naturally moves northward, westward and some eastward to serve the domestic consumer. In this case, in contrast to the procedure in the eastern naval stores centers, the product moves direct from the still, thereby saving extra labor, unloading and storage charges, yard expenses, etc. The inspection is done by competent road inspectors consigned to a particular territory.

The balance of the production serves the export trade. Such movement is handled in either one of two ways, according to the particular conditions existing at the time of the shipment. The turpentine and rosin can be sent to any one of the storage yards and held as stock or awaiting arrival of the vessel. Then it is either drayed or handled by the Public Belt Railway at a nominal charge, direct to the steamer.

Most of the exports, however, are made direct from the still. In this case the delivering road hands the car over to the Public Belt Railway to be delivered to the dock. Here it is unloaded and rolled to the steamer. Seven days free time are allowed. Beyond this time there is a nominal charge for track storage. Modern mechanical labor-saving appliances are being rapidly installed.

New Orleans is the southern terminus of the government's barge line which operates on the Mississippi river between St. Louis and New Orleans. The revival of river transportation by the government has proved entirely feasible and successful and is proving of material benefit to shippers desiring a low domestic rate. New Orleans is preparing to turn over to the government a strategic site for the erection of a modern terminal for the barge line.

MOBILE

(By Lee F. Irwin.)

THE naval stores business of Mobile is handled through two enterprising houses, Taylor, Lowenstein & Co., and the Alabama Naval Stores Co., but there is ample space available for yards both along the city side of the river and upon the islands forming the opposite bank, less than half a mile across. There are also dockage facilities in plenty, those of the municipality and the various railroads being available to the public.

There are two private naval stores yards in operation at Mobile. Taylor Lowenstein & Company have one of the finest yards in the South, with ample capacity, located on the west side of One Mile creek, 700 feet from the river and the Mobile & Ohio piers. There is a fifteen foot depth of water in this creek at high tide, making possible the entrance of large barges to the yards of the company. Ocean steamers may be loaded at the mouth of the creek. The yard of the Alabama Naval Stores Company is located on the river, just south of the docks of the Mobile Coal Company, and has a large capacity. It was formerly the yard of the Union Naval Stores Company, which went out of business in 1917. Neither of the naval stores yards is open to the public for storage purposes. Storage sheds for turpentine are not operated by either company, this commodity being shipped out as fast as it is received at the yards. There is storage capacity for spirits turpentine, (including Standard Oil Co.) of 12,000 barrels, but this is not open to the public.

The approximate receipts of naval stores at Mobile annually are given as 60,000 to 70,000 barrels spirits turpentine and 250,000 to 300,000 barrels rosin. This is shipped approximately as follows: Domestic, 60 per cent. to the interior; export, 40 per cent.

PENSACOLA

(By H. A. Lurton.)

[Mr. H. A. Lurton, Vice President of Jennings Naval Stores Company and in charge of its business at Pensacola, Fla., has been connected with the naval stores industry for seventeen years, having commenced his naval stores career with J. P. Williams Company as account sales clerk during the early spring of 1914. After serving two years in this capacity he was transferred to merchandise department, continuing in this department as shipping clerk and traveling salesman for five years, the Pensacola business then being operated under the name of Williams Naval Stores Company, later the late T. Albert Jennings acquiring controlling interest and subsequently changing name to Jennings Naval Stores Company. In 1902 he was transferred to the naval stores department as traveling representative, during which time he acquired interests in producing companies in Louisiana. In 1914 he was promoted to Vice President having direct supervision over all operating accounts, which position he holds at present.]

THE first naval stores business of any considerable size in Pensacola was established in 1895, when the firm of A. M. Moses & Co. was founded with yards near Pensacola, at a point known as Moses Station, now the site of Goulding, near which the Pensacola Naval Stores & Storage yards are at present located.

During 1897, A. M. Moses & Co. transacted quite a volume of business, their approximate receipts for that year being 40,000 casks of turpentine, valued at $600,000, and 160,000 barrels of rosin, valued at $480,000.

This firm operated for several years, being followed by the S. P. Shotter Co., J. R. Saunders Co., the Union Naval Stores Co., the Consolidated Naval Stores Co. and the J. P. Williams Co. After the death of Mr. J. R. Saunders the J. R. Saunders Co. was liquidated, and the Saunders Co. was established, but remained in business only a short time.

Pensacola has since the beginning (excepting one or two short intervals) been a "closed" or contract market, prices being based on the Savannah market, this "closed" or contract market being copied from the Brunswick, Ga., market, as Brunswick was the first port to establish this method of trading in turpentine and rosin. From 1894 until 1920 both turpentine and rosin have been sold in Pensacola at so much under the Savannah market. This year, however, all contracts by factorage houses are based on a differential over Savannah, which is naturally gratifying to the producers in this territory.

Pensacola has two large naval storage yards, both having practically unlimited capacity. The present yards without enlargement, however, (and for which there is ample room) have a combined capacity of 600,000 barrels of rosin without double decking, and 36,000 barrels of tankage space for turpentine. These yards are owned by the Pensacola Naval

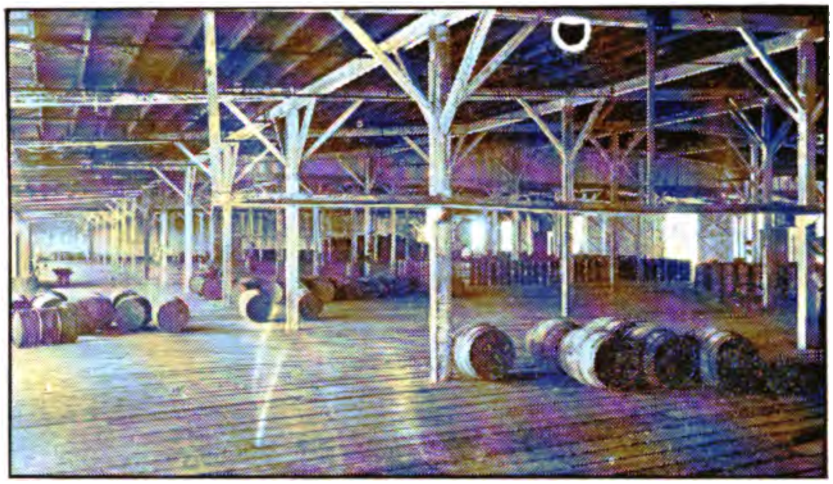
Stores & Storage Co., and the Naval Stores Warehouse and Storage Company. We believe that the storage capacity for rosin at Pensacola is greater than at any other point in the country, and it is an established fact that the tankage space used exclusively for turpentine is greater nowhere than in Pensacola. One splendid advantage that this port has over other ports with reference to its yards is that they are not situated on the water front and are therefore in no danger from storms or high water. The transfer from dock to yard, and yard to dock, is very reasonable, a minimum charge of $2.00 per car being charged for this purpose.

Pensacola as an export point for naval stores was at its best during the period extending from 1907 to 1912, when the annual receipts of naval stores amounted to between 75,000 and 100,000 casks of turpentine and 250,000 to 300,000 barrels of rosin. A very large proportion of these receipts was exported, principally to Hamburg, Rotterdam and to the United Kingdom. Pensacola has not yet regained her normal pre-war state in so far as exporting of naval stores is concerned. This is due entirely to conditions that were brought on by the war. Prices of turpentine and rosin were sent down to such a low point that production was largely decreased, but the better prices last year brought about a revival in the industry in the territory adjacent to Pensacola, and from present prospects the receipts at this point for 1920 and for the next several years to come will range around 50,000 casks of turpentine and a proportionate amount of rosin.

There are several large tracts of timber that have yet to be turpentined, which, with the thousands of acres of timber that are now being turpentined, will insure Pensacola receiving her proportion of the turpentine and rosin for the next ten years. In the immediate vicinity of Pensacola, there are no large tracts of round timber, but there is quite a bit of operating going on in a small way, the finished products being hauled by trucks to the naval stores yards. One new place was opened up this season with six crops of virgin and a reserve of twelve crops, all within thirty minutes' ride of the storage yards.

Comparatively cheap ocean rates exist from this port and there is every reason to believe that the future exporting will equal, if not surpass, the banner years of 1907-1912 as soon as stabilized ocean rates are put into effect. Every facility is to be had here, and an excellent opportunity is awaiting the exporter who is wise enough to develop his business through this port.

The depth of the channel at low tide is 31 feet, depth at the docks 32 feet, and the largest steamers afloat in freight transportation can easily come into the harbor and load without difficulty. The United States Government report shows that from the entrance to anchorage off the city of Pensacola, a distance of nearly seven miles, not less than 32 feet of water can be safely carried. The entrance to the channel is well marked by accurate ranges and buoys, void of embarrassing turns, and is easily navigable under almost any condition of weather. The extent of harbor anchorage, depth of water at piers, and the character of piers already in existence make Pensacola the most advantageous port on the Gulf for exporting of naval stores.



Loading Berth Shed on Wharf with Accommodation for 10,000 Casks Turpentine

Size of Receipts by Years: Since Pensacola's Chamber of Commerce began to keep naval stores statistics the receipts of the port have been as follows for the seasons ending March 31:

Season.	Turp. Bbls. Spirits (50 Gals.)	Rosin Bbls. (500 Lbs.)
1919-20	35,973	142,339
1918-19	29,833	101,426
1917-18	56,404	194,899
1916-17	68,580	238,018
1915-16	64,820	236,536
1914-15	73,711	240,691

The Newport Tar & Turpentine Co., operated by the General Naval Stores Co. of New York and Chicago, established several years ago a plant in this city with a capacity of forty casks of turpentine per day and 140 barrels rosin. This plant operates entirely upon wood stumps, which are drawn from the immediate territory surrounding Pensacola. They have an investment in the plant amounting to over one-half million dollars, and have been running to capacity since opening up. The Pensacola Tar & Turpentine Co., operating several miles east of the city, are also engaged in the manufacture of wood turpentine and all of the by-products derived from the pine tree stump. The Western Paper Makers Chemical Co. have recently opened up a refinery at Pensacola, but are confining their operations to the distillation of rosin and turpentine from batting dross and chips. This latter concern has taken over the A. E. Turner Co. plant and the Union Naval Stores Co.'s plant, which makes them the largest operators of this kind in this section of the country.

THE PRODUCTION OF CRUDE "GUM" BY THE PINE TREE

By ELOISE GERRY.

(Microscopist, Forest Products Laboratory, Madison, Wisconsin.)

[Miss Eloise Gerry has been on the staff of the U. S. Forest Products Laboratory as Microscopist since 1910. Her work is the investigation of the microscopic structure of wood in relation to its identification, properties and uses. She is a graduate of Radcliffe College, Harvard University of the Class of 1908, and received the Master of Arts degree from the same institution in 1909. While there she specialized in Chemistry and Botany and carried on an investigation on the structure of conifers which was published in the "Annals of Botany," a British journal. She is a member of Phi Beta Kappa and Sigma Xi, honorary scholastic fraternities. Miss Gerry has contributed material on the microscopic structure of wood which has been published in various government bulletins and has also published articles on the occurrence of tyloses in American woods, the structure and fiber lengths of pulp woods and the penetration of preservatives into various species of woods. During 1916 and 1917 Miss Gerry made a special field study in Mississippi, Louisiana and Florida, of the behavior of southern pines as turpentined by various methods. During this work she had an opportunity to meet many of the woods operators and other experienced turpentine men, and she desires at this time to gratefully acknowledge the interesting and helpful information and specimens which she obtained in this way and which greatly assisted in the interpretation of the facts as shown in the microscopic investigation.]

OLEORESIN PRESENT NORMALLY IN UNBLED TIMBERS: Pine trees from their earliest years form a substance known as pitch, or oleoresin. This is found in the various parts of the tree, including the leaves and roots; but it is the oleoresin in the wood of the trunk that is of primary importance in the production of naval stores. This gum is located in so-called "resin passages" or spaces between the wood cells, such as are shown in plate I, figures 1 and 2 at "D," photographs taken through the microscope of a cross section of the wood of longleaf pine (Pinus palustris Mill.). Longleaf pine will be used in this discussion as a typical turpentine tree, the behavior of the slash pine (Pinus caribaea Morelet), also an important species, being fundamentally very similar.

The cells which are to yield gum are formed from the cambium layer, that narrow ring of delicate soft cells which lies between the bark and the wood. See plate I, figure 4, at "C." (The cambium is the layer that tears when the wood is separated from the bark cylinder in making a willow whistle.)

During the growing season the cambium forms the bark on the outside and on the inside the wood of the new annual ring by the division and growth of its simple cells into the more specialized wood cells, which develop variously into wood fibers (T), ray parenchyma cells (MR) and other parenchyma cells (GP). See plate I, figure 3, and other figures. The special thin walled or parenchyma cells of pine which are associated with gum production occur in groups or clusters which very frequently split apart at the center to form more or less open spaces, the so-called resin ducts, canals, or passages. Frequently, however, the writer has found that no actual opening is present and that gum exudes directly from the groups or clusters of these parenchyma cells (plate I, figure 4, GP) which differ from the wood fibers or tracheids surrounding them in a number of ways. The gum-producing cells, for instance, remain alive and actively functioning for several years, or until approximately that time when the inner rings of sapwood change into the heartwood, the dead part of the tree at the center of the trunk. The heartwood is not active in the transfer of sap; it is generally darker in color than the sapwood, and often is more or less saturated with pitch. When analyzed chemically the heartwood is found to contain a higher percentage of resin than the sapwood, but it is in the sapwood that the resin is being manufactured. The sapwood may be called the naval stores operator's resin factory. It is here just under the bark, in the outer layer made up of a varying number of the annual rings of the wood, that the actively gum-yielding clusters of parenchyma cells are found. They remain alive longer than the other wood cells or fibers and are able to grow and act upon the materials that are brought into them or stored in them during the growing seasons. The wood fibers, or tracheids, although dead in less than a year after they originate at the cambium, function nevertheless in the sapwood, somewhat like water pipes, in the conduction of sap. The yield of gum evidently, therefore, depends very largely upon the health and activity of the thin-walled or resin producing parenchyma cells in the pine sapwood. They are like the goose that laid the golden eggs—if well treated, the yield is high, if abused or killed the source of the supply is lost. (Note plate II, figures 3, 4 and 5). Obtaining naval stores is not, therefore, merely tapping a storage reservoir. It may be carried on so as to husband the production of gum, "orcharding" oleoresin in very much the same way that the horticulturist fosters the production of apples or peaches in his orchard.

The groups of resin-yielding cells are arranged in two systems; one, the larger, extends vertically in the tree (plate I, D and GP); the other horizontally (plate I, figure 6, H). These groups or passages frequently connect with each other at points where they cross. By stripping off a piece of bark and laying bare one square inch of sapwood of longleaf pine, 300 to 400* of the horizontally extended rays, each containing resin-yielding ducts or cells, would be exposed. See plate I, figure 6 at H. The vertical ducts, or centers of resin production, usually occur in or near the summerwood (the denser, darker portion of each annual ring). The average number normally present in "round" timber is illustrated in plate I, at the lower part of figures 1, 2 and

*Division of Forestry Bulletin 13, p. 152.

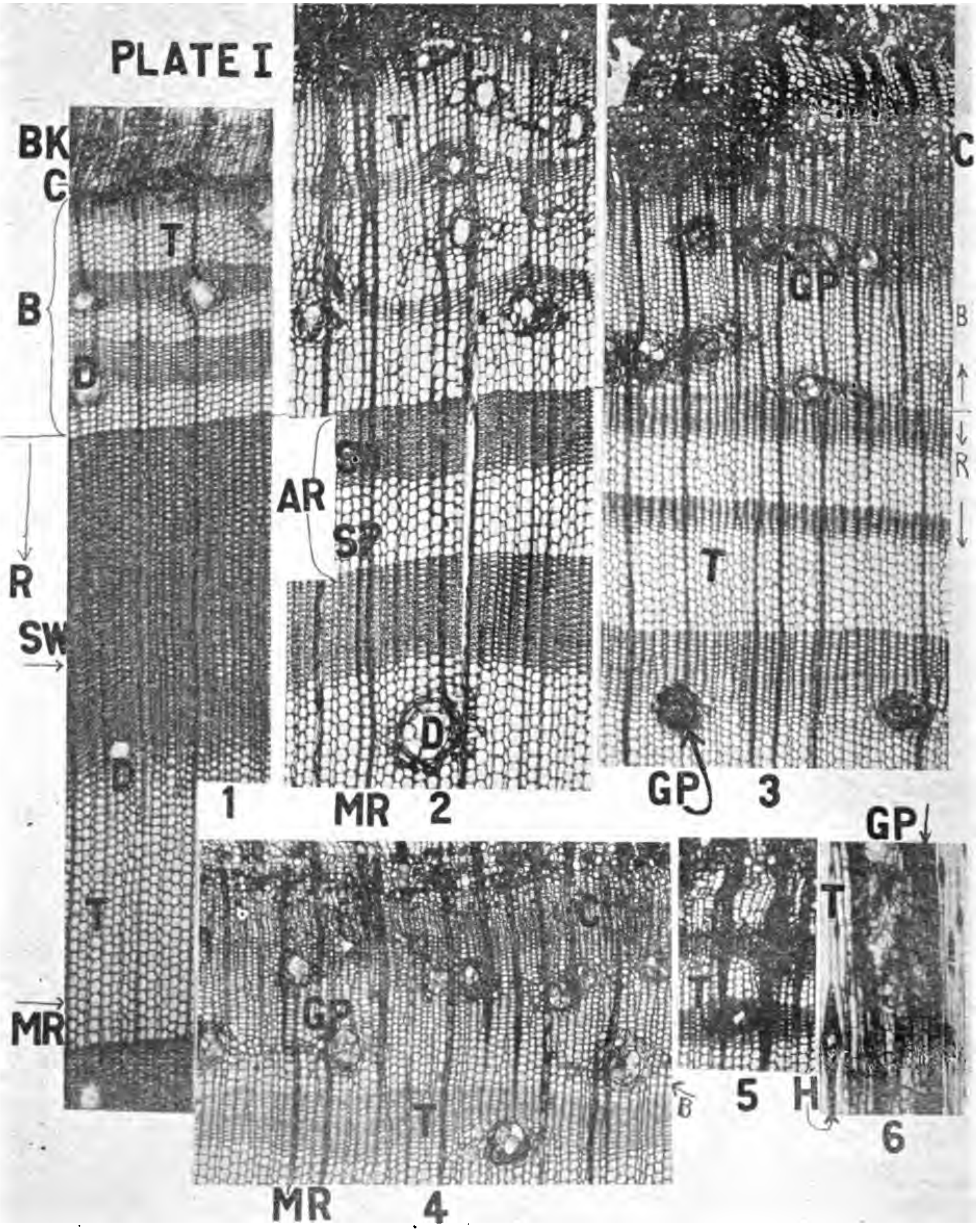


PLATE I
BK
C
T
B
D
R
SW
MR
AR
SP
GP
H
1
2
3
4
5
6

PLATE I

Description of Figures

"C," cambium.

"B," wood formed by "bled" timbers.

"R," wood formed in "round" timber.

"T," wood fibers or tracheids.

"MR," rays.

"AR," annual rings, one year's growth.

"SW," Summerwood.

"SP," Springwood.

"D," "gum" duct or resin canal.

"GP," Group of "gum"-yielding parenchyma cells, not opened to form a canal.

"D" and "GP" make up the **vertical** system of "gum"-yielding tissue.

"H," **Horizontal** resin duct as seen on surface of face or in plain-sawed lumber.

"BK," Bark.

Figure 1.—A cross section of a young fast-growing tree that was heavily turpentined for three years. Note reduced width of annual rings in "B," compared with growth before turpentining "R," also great reduction of summerwood "SW."

Figure 2.—A tree also turpentined for three years. Note more numerous but smaller ducts in "B" than in "R" (lower portion). Summerwood reduced here also.

Figure 3.—A "virgin" operation with narrow chipping, growth was not reduced in this tree; sample was cut in midsummer. Note abundant resin-producing cells, forming series "GP."

Figure 4.—Similar to 3, but shows more clearly cambium, "C," and the individual, living "gum"-yielding parenchyma cells in groups or clusters, "GP."

Figure 5.—Cross section of new growth in springwood. Only tracheids, "T," have yet formed in new growth ring—no ducts yet present.

Figure 6.—Lengthwise view of vertical "gum"-yielding system, "GP," and end view of horizontal system at "H."

PLATE II

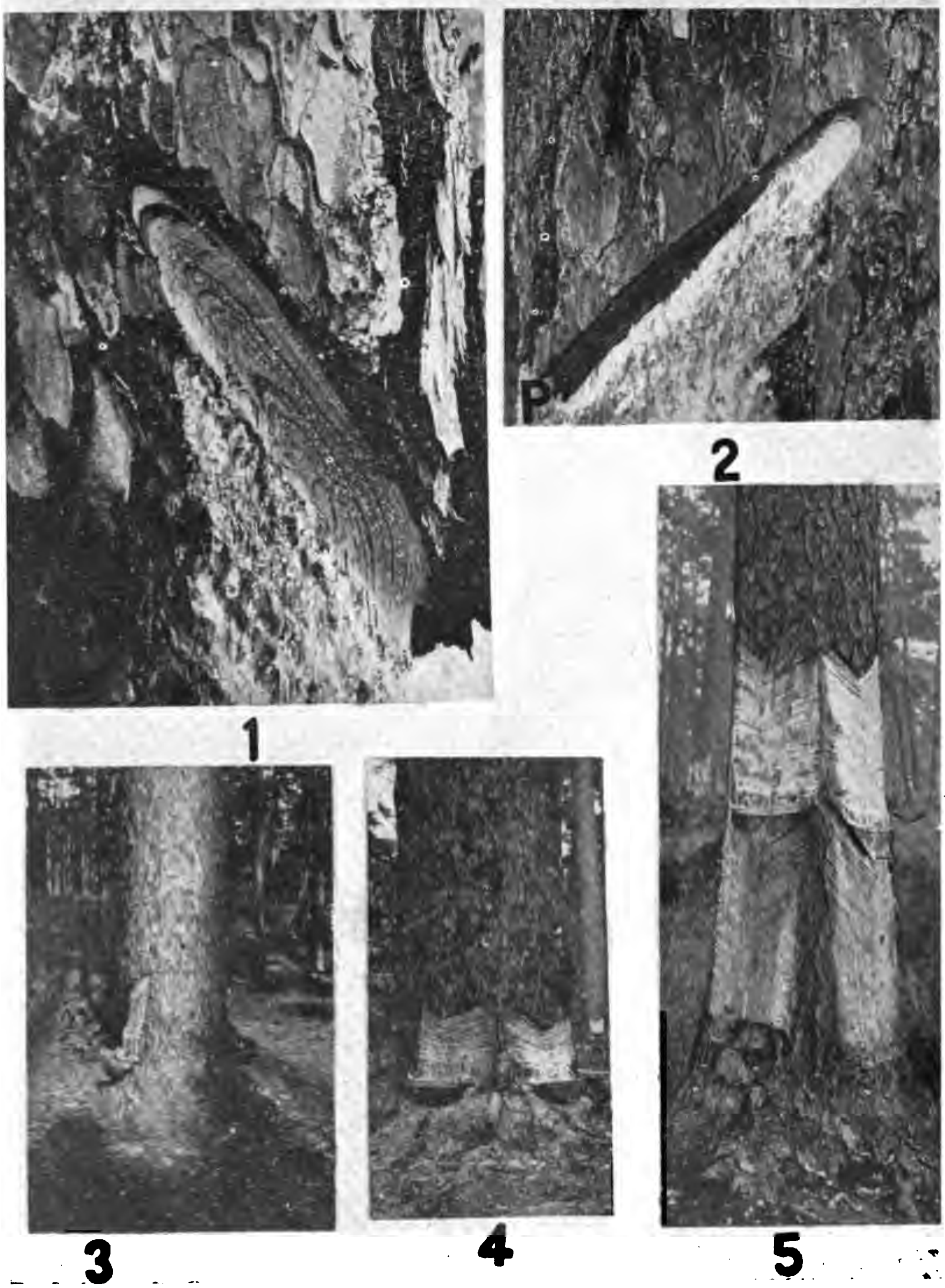


PLATE II.

Description of Figures.

Figure 1.—Photograph taken in December of a fresh streak from a "narrow" chipping (chip ¼-inch high) experiment at the end of its second year: "Gum" running freely. Each drop indicates the presence of a "gum" duct or cluster of "gum"-yielding cells. At least 12 rings of growth are exposed. At least 10 of these were formed by the "round" timber and it is easy to see that they are yielding gum Note the close line of drops exuding near the peak from series of gum-yielding cells like those in Plate I, Figure 3, formed in new growth after turpentining.

Figure 2.—A fresh streak, from a tree that had been chipped **twice** a week for two years. This shows the effect of too severe stimulation in the tendency of the tree to "dry-face" and produce lower yields as time goes on. The drying occurs first at the "peak," "P," where the "gum"-yielding cells are in the most unnatural condition as regards moisture, etc.

Figure 3.—Proper placing of faces on a tree.

Figures 4 and 5.—A thoroughly bad placing of faces that means waste and loss from start to finish.

3 at D and GP. Tschirch** in his drawings of pines and other resin-producing plants shows all ducts open at the center, with a structure somewhat different from that shown in the accompanying photographs. He describes a special membrane lining the resin passage or duct, in which he believes that all the resin is manufactured from substances conducted to it. He states that he found no resin formed in the parenchyma cells round the canal. Tschirch, however, did not work on pines that yield oleoresin as abundantly as longleaf pine, and the technique which he used in preparing his specimens for study might perhaps tend to obscure or destroy the structure of the thin-walled parenchyma cells which are shown in the accompanying photomicrographs. Furthermore, the fact that gum or oleoresin has been observed by the writer to exude freely from clusters of parenchyma cells which showed no separation or formation of any canal or duct (see plate I, figure 4, GP), would at least indicate that other possibilities of resin production than those which Tschirch describes may be active in the case of longleaf and slash pines. This point of view appears to receive further support from the fact that not only his anatomical observations but also his deductions are open to question, especially on physiological grounds.

OLEORESIN IS NOT THE TREE'S SAP: It is often stated that the gum of the pine is like the sap of the maple. This, however, is not true. The pine has a sap which is a water solution similar to maple sap, but it is quite different chemically from the oleoresin or gum. The sap circulates between the roots and leaves through the fibrous cells of the sapwood and also through the cells of the soft inner bark. The oleoresin does not circulate through the tree in this way. It is associated with the excess of materials not used up in the production of wood, leaves, and bark, but stored inside the wood.

CHANGES RESULTING FROM TURPENTINING. NORMAL TISSUES STIMULATED: In the sapwood already present in the round timber the visible structure is unaffected by turpentining because wood formation is already completed. The wounding, however, appears to stimulate the activities of the living parenchyma cells already present. This response to the wound stimulus seems to account for the results secured by Dr. Herty* when experimenting with the so-called "advance streak"—a single chipping placed on the timber in late winter or in very early spring, a month or more before the regular turpentining season began. It was found by Dr. Herty and subsequently by many others that a larger yield, meaning financial gains of thousands of dollars, was obtained from trees thus treated. This was not, as Professor Tschirch led Dr. Herty, at that time, to assume, because additional resin ducts were formed immediately after the chipping which gave an increased yield at the first dipping. On the contrary, no new ducts are formed at this time; and the increase in yield appears to be because of the stimulated activity of the resin yielding tissues already present in the outer sapwood. In this way, in a virgin operation, the normal resin-producing ducts or cells may fill the cups not only for the first, but also for the second or even sometimes for the third dipping before any new ducts are formed. In one operation this meant a production of 16 to 24 barrels of gum per crop per month from the stimulated resin tissue already present in the wood formed by the round timber.

NEW WOOD FORMED SHOWS DIFFERENCES IN STRUCTURE: After a tree has been chipped, the new wood which forms in the vicinity of the face differs from the normal wood in a number of ways. (Compare in plate I, figure 1-4, B, bled timber with R round timber.) One of the most striking differences is the formation of many more resin-producing ducts or clusters of cells than are normally present. (See plate I, particularly figures 2, 3, and 4). These additional resin ducts, as far as the writer has observed in the case of material collected during two successive years in Mississippi, Louisiana and Northwestern Florida, are not formed, at the earliest, before the latter part of April or May and are not well developed in many cases until June, July and August. Some rows of wood fibers are, for the most part, formed first, before the resin ducts (plate I—especially figure 5, at T), although in turpentined pines this resin-yielding tissue is formed much earlier than in the normal pine wood. The ducts often form rows or series. (See plate I, figures 3 and 4, at GP.) The first formed clusters of resin-yielding tissue are largest and are generally located in the springwood of the annual ring. They vary in size; sometimes they are as large as, or rarely slightly larger than, the ducts or clusters found in the round timber; very often they are smaller. Often several series, sometimes closely packed, sometimes scattered, are formed in the transition wood and in the summerwood as the season progresses. These latter ducts or clusters of cells are generally smaller, though more numerous, than those ordinarily found in the round timber. As the season's chipping continues, perhaps during October and November, it sometimes appears that less ducts are present per unit area of cross section than were to be noted in July, August or September. This might indicate that some of the newly formed ducts are short, not extending for any considerable distance upward in the tree, and that the chipping has entirely removed them. The cross sections photographed in figures 1 and 2, plate I, were made late in the season and show that at this height of the face practically no ducts are present in the early springwood of the annual rings formed after turpentining. This is a matter which is to be investigated soon. It is usually the resin-forming tissue in the springwood which appears to be lacking under these circumstances. The terms "primary" and "secondary" have been applied to the ducts normally present in round timber and to those occurring after wounding, respectively. These terms seem unsatisfactory, hence "normal" in place of "primary," and "induced," "wound or traumatic" in place of "secondary" are suggested as substitutes, since they are more descriptive of the conditions existing. Furthermore, it is as yet impossible, in the writer's opinion, to say which of the ducts formed after wounding would have been present had the timber not been turpentined and which are the so-called secondary or induced ducts.

GUM OBTAINED FROM THE NORMAL DUCTS OF THE ROUND TIMBER NOT A NEGLIGIBLE MATTER: Careful inspection of a fresh "virgin" streak and also of older operations will show that a considerable number of

**Die Harz u. die Harzbehalter. Bern 1906.

*Herty, C. H. "The Turpentine Industry in the Southern States." Jour. of the Franklin Institute, March, 1916, p. 362.

annual rings are often exposed. In each ring the normal or ordinary ducts or resin-producing tissues are present and gum exudes from this tissue in droplets. (See plate II, figure 1.) Hence it is obvious that no inconsiderable part of the gum is obtained from this source. As the new wood develops after wounding with its increase of resin yielding tissue, the droplets of gum often appear in lines instead of single droplets, since they exude from a series of ducts or cell clusters like those shown in plate I, figures 3 and 4, at GP).

Theoretically the yield of resin should increase from year to year since the amount of resin-producing tissue is constantly augmented. Under the best operating conditions it is quite possible that such a condition might be realized or at least approximated, provided the wood in the vicinity of the streak did not become too dry or otherwise decline in productive activity

CHIPPING IN THE LIGHTWOOD: When the experiments in narrow chipping (chips ¼ inch in height) were first instituted by the Forest Products Laboratory experienced operators shook their heads and said that the method would fail. "Successful chipping must keep ahead of the lightwood." From the studies of the structure of the wood of the trees where narrow or low chipping streaks (¼ to ½ inch in height) was used, from inspection of trees in the field, and from information obtained from practical operators, the writer is convinced that to obtain a sustained high yield a thin chip only should be removed when the surface of the streak is freshened. This necssarily means chipping in the lightwood—the pitchy, often somewhat darkened wood just above the streak—at least at some seasons of the year. The response of the tree when it is chipped is a transfer of materials to the wound in an attempt to heal it as quickly as possible. The gum normally present flows out coating the surface, thus serving as a substitute for the bark by tending to prevent the drying of the sapwood. The stimulus from the cut is most intense near the streak and gradually decreases farther away from the wound. Tissue associated with resin-production is usually formed at the expense of wood fibers near the wound so that the amount of summerwood is frequently reduced in the new growth made by turpentined timber. If a high chip is taken off the most responsive tissue containing the best machinery which the tree could develop to heal the wound and incidentally to produce gum is removed. When a chip three-fourths of an inch or an inch in height is cut each week a whole organized battery of the tree's forces is wiped out at each stroke of the hack and a new organization must be mustered afresh and adjusted to meet the new situation. Nature responds valiantly again and again but much good effort and productive tissue are wasted. Yet, on the other hand, the tree must be chipped, because the parenchyma cells exposed on the surface at each chipping dry, cease functioning, and die. They also become clogged with the dried and hardened gum. The removal from the surface of the least amount of wood that will insure a renewal of the activity of the resin-producing cells appears to be the goal to attain. The process of turpentining may be compared to a race. A jockey drives a horse to make a record just as a turpentine operator "works a crop" to make a yield. If the race is short,—a half mile—the jockey drives his horse as fast as possible for the brief time involved. He may whip the horse to stimulate him to use his energy reserves to the utmost. Imagine, however, a jockey with a long race,—ten or twenty miles—before him. Suppose he begins by whipping his horse, stimulating him to his utmost, in the first mile. Each time the horse begins to lag the jockey would flog him again and again. At first the horse would respond to each stimulation from the whip with a new burst of speed, but, after a time, although the effort was made, the response would become weaker and weaker until the jockey would finally be beating a dying animal to death. No one could consider such treatment of the horse profitable. No one should consider a corresponding treatment, the heavy chipping of pines, good turpentining. The large percentages of dead and "dry-faced" trees that can be found in turpentined woods demonstrates clearly the wasteful results of such practices. Another destructive mistake which can readily be avoided is the improper placing of faces on the trees. This is illustrated in plate II, figures 4 and 5. Placing faces too close together, without sufficient uncut bark between them exposes them to excessive drying, which kills the resin-producing cells. Such treatment reduces, from the beginning of the operation, the possibility that the resin-producing tissues can keep healthy and yield a proper return for the cost of the labor of chipping.

The turpentined tree responds freely to stimulation, but the wise operator will control that stimulation and gain from it by husbanding its results to the utmost instead of casting them useless to the ground as a thick chip from the hack or placing the faces so that the responsive energy of the tree is inhibited by a too great surface being exposed at one point. The most successful flow of gum will come from the somewhat stimulated resin-yielding parenchyma cells of the pine which are otherwise in as normal a condition as possible with reference to such factors as moisture and food supply. For example, the corner of the streak generally runs better than the peak, which is the place where dry-facing usually begins. See plate II, figure 2, P. Faces opposite each other where the wood of the streak is under more normal conditions yield more gum than those side by side as in plate II, figures 4 and 5. Figures 1 and 2, plate II, were photographed in December at the end of a "yearling" operation. Figure 2 may be compared to the exhausted race horse—the crop, of which this tree is a specimen, had been chipped twice weekly with a ¼-inch streak, for two years. Many trees were beginning, like this one, to dry-face, although the yields were only just beginning to fall off. The stimulation and removal of resin producing tissue appeared to be excessive in this case. Figure 1, on the other hand, shows a tree chipped ¼ inch once only each week for the two years. It is a specimen of a crop which even in December was running well and in which the resin-producing tissue was healthy and active. The prospects for the crop were bright with the promise of a sustained yield for several years to come. The yield here was higher the second year than the first; also during the second year this crop yielded practically as much gum as heavier chipping and used about half as much chipping surface or height of face.

CONCLUSION: Microscopic study of the structure of specimens of southern pines, which have been turpentined by various methods, has brought to light much other interesting information which cannot be given in detail here. But it conclusively shows that there is a record within the trees that discloses the possibilities of better turpentining practice to any one who can and will find and profit from the facts demonstrated. It indicates the advantages, both to the tree and to the operator, that may be gained through conservation in the use of this valuable natural resource by securing, with the least injury to forest or timber, more and better naval stores from each tree

THE DOUGLAS FIR OF THE PACIFIC COAST AS A FUTURE SOURCE OF TURPENTINE AND ROSIN

By THOMAS GAMBLE

[The Douglas fir is under investigation as a probable source of naval stores supplies when the destruction of the pine forests of the Southern States absolutely forces the development of every available means of procuring turpentine and rosin and permanent high prices make it possible to utilize sources that at this time are not available because of the disparity between the high cost of production and marketing and the prices secured for the output. Such information as has been obtainable is furnished herewith for the guidance of those who may contemplate probing deeper into the matter of utilization of the vast areas of the Douglas fir over the great stretch of country in the Northwest.—T. Gamble.]

FREQUENT reference has been made, especially in the past year or two, to the Douglas fir, of the northwestern part of the United States—Washington, Oregon and Alaska—and also of British Columbia, as the probable source of future great supplies of turpentine and rosin. The enormous area of the forests of this tree, greater, it is stated, than the area of any other specie in North America, makes the question of their use for naval stores a matter of extreme importance to the industry and to the consuming world at large.

While it has been known for a number of years that the Douglas fir could be made a producer of turpentine and rosin, both by the natural process of tapping the tree and the distillation of the products from the stumps and branches and other waste of the tree, the experiments have never been accepted as conclusive that the results would be satisfactory from a financial standpoint, or that the claims of those urging the development of the industry in that section could be justified by the results obtained. Fifteen or twenty years ago there were small plants for the distillation of turpentine and rosin in the Northwest and occasional references to the Douglas fir as a future competitor of the southern long leaf pine were found in the trade papers. In April, 1910, the "Electrical World" contained an article on the "Electrical Distillation of Turpentine at Vancouver, B. C.," and it was declared "a successful process for the abstraction of by-products from the wood waste of that territory." The turpentine was declared "equal to the best southern spirits of turpentine," and a table was given of the quantities of various products claimed to have been obtained in the treatment of 40,000 pounds of the Douglas fir, or British Columbia fir, as follows:

Turpentine	7.5 gals.
Tar Oil	18 gals.
Resin	38 lbs.
Charcoal	1,338 lbs.
Pitch	20 lbs.

In this connection it is well to note that in 1916, in the pamphlet on "By-Products of the Lumber Industry," issud by the U. S. Bureau of Foreign and Domestic Commerce, Prof. H. K. Benson stated that "in the case of Douglas fir the wood for distillation must be carefully selected in order to approximate the yield obtained from the long leaf pine. This, in part, has rendered the industry unprofitable on the Pacific coast when operating along the same lines as in the South." Prof. Benson (University of Washington, at Seattle), in a paper read before the Eighth International Congress of Applied Chemistry, and published in the Scientific American Supplement of June 7, 1913, reviewed what had been done with the waste of the Douglas fir (Pseudotsuga taxifolia) by steam distillation, destructive distillation, and also fermentation products. This paid little attention to turpentine or resin products, dealing with oils and other products obtained. Said Prof. Benson, and his words still hold true, "In the states comprising the Pacific Northwest of the United States, the extent of the land from which the forests have been removed is measured in millions of acres." The resulting stumps and other waste furnish seemingly a never ending source of supply for distillation plants.

Other publications scattered along through the intervening years show that the interest in the Douglas fir as a source of profitable operation by steam or destructive distillation processes continued, but the plants in operation, several of which were reported in 1911, were small, apparently did not meet with a sufficiently pronounced success to induce others to invest in similar enterprises, and the industry has never reached any magnitude or obtained any special consideration. Generally they were regarded merely as interesting experiments. The industry, in any and all its phases, was absolutely negligible when the World War began.

The effect of the war in curtailing production in the South and advancing prices to hitherto unknown figures, together with the reports of the rapid approach of the time when the long leaf pine forests would find their output of naval stores seriously lessened by the destructon of the trees, awakened and accentuated an interest in the Douglas fir. Attention then centered less on the use of the fir stumps and waste wood and more on the extraction of the gum from the living tree, a process which apparently had received very scant consideration up to that time.

Inquiries made along this line brought the following letter from the editor of "The Timberman," of Portland, Oregon, the leading journal in that line on the Pacific coast:

"Relative to the destructive distillation of the Douglas fir, I wish to state that the one plant engaged in this industry discontinued operations several years ago. There is a small plant in Portland, known as the Northwest Turpentine Co., which has been producing a limited amount of turpentine from the Douglas fir pitch (gum).

"The old growth Douglas fir trees, especially those having a decided lean, are often found to have large pockets of pitch, yielding as high as forty or fifty gallons, which furnishes a very high grade of turpentine. This pitch (or gum) is obtained by boring.

"There have also been experiments conducted in the western yellow pine region east of the Cascade mountains. A company in Birmingham, Ala., last year made tentative plans, leasing a large acreage of this timber for experimental purposes, but thus far nothing has come of the enterprise. It is a question whether turpentine in any great amount can be obtained from this western yellow pine, owing to the fact that it grows at high altitudes with cold nights, making the flow of gum rather sluggish."

Referring to the company mentioned, "The Timberman" had this to say of its plans and methods:

"Pitch extracted from Douglas fir timber yields about 25 per cent of high-grade, water white turpentine, according to a series of tests made by the Northwestern Turpentine Co., of Portland, which has recently begun the distillation of turpentine on a commercial scale. The company has also been able to show that fir trees may be tapped without injury.

A Forest of Douglas Firs.

"The fir pitch is obtained by boring the tree below the stump line as near the ground as possible with a five-eighths or three-quarter-inch ship auger. The pitch seam or pocket may be encountered in six or eight inches but frequently the hole must be bored deeper, in some cases even to the heart of the tree. When the pitch seam is encountered, a trough is inserted below the hole and the pitch drained into a receptacle. When the flow stops, a plug is driven into the hole, to prevent any possible infection of the tree.

"The company has some interesting exhibits which indicate that the trees are not injured in the tapping process. Photographs of these exhibits are reproduced in this article. For many years, it seems, certain ranchers and woodsmen have been systematically collecting fir pitch and selling it under the name of "balsam." The company has been able to locate several of these trees, some of which were tapped 27 years ago, according to affidavits by farmers on whose lands the trees were tapped. No effort was made by the "balsam" gatherers to seal the holes.

"The trees were felled by the company and the sections containing the holes were carefully cut out. One exhibit shows the open hole on the inside of the piece with the bark and wood entirely grown over the mouth of the hole. The section shows 27 annular rings from the bark to the point where the hole was started, proving that the tapping was done in 1892. It is quite evident that the hole had not been sealed as no trace of a plug could be found. In spite of the fact, no signs of local decay or discoloration of the wood surrounding the hole can be seen. The sides of the hole were covered wth dry pitch which apparently acted as a preservative. Other exhibits show holes that have not grown over and like the one above cited show no signs of local rot.

"The apparatus used in the distillation of turpentine from fir pitch consists of four steel drums into each of which a two-inch steam pipe is fitted. This steam pipe is perforated in numerous places and is inserted vertically into the drum, almost touching the bottom. The drums are then filled about two-thirds full of pitch and the steam slowly turned on, which is injected directly into the material through the perforations. The steam pressure and temperature are carefully regulated to hold the heat to 210 degrees Centigrade. As the pitch begins to distill the turpentine is driven off in gaseous form into the condensation system. Here the steam and turpentine vapors are condensed, and a mixture of water and turpentine is drawn off. The turpentine is then syphoned off into tanks and is ready for the market.

"The condensation system consists of a three-inch iron pipe built in the form of a worm, which is enclosed in a water jacket through which a stream of cold water is kept circulating.

"After the turpentine is distilled the residue left is a yellow, sticky mass, which is removed while hot and boiled in a large, flat vessel called a rosin pan. Gas flame is used for this purpose. The boiling process is to drive off the moisture injected by the steam in the first operation. When the mosture is removed by the direct heat, the remaining substance is pure commercial rosin.

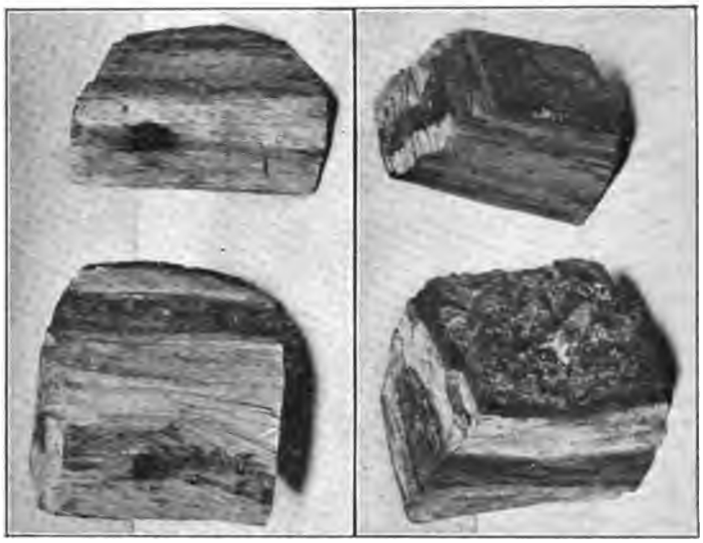
"All fir trees contain more or less pitch, but there are only certain localities where the majority of the trees are profitable to bore. The best producers are the large, old growth yellow firs, that are alive and healthy. Good producers are often rough and conspicuous by large burls. A swell butted tree or one with a decided lean is almost a sure sign of a good pitch tree. However, signs sometimes fail, and indications may vary in different locations.

"The company claims that the removal of the pitch ahead of the falling crew materially reduces the fire hazard. Often during the falling or bucking of a large tree a large amount of pitch is liberated which flows over the ground and forms a serious fire menace in case of dry weather. By draining the trees and sealing the holes the danger is said to be reduced."

About the same time came the announcement that The Douglas Fir Turpentine Co. had been organized at Vancouver, B. C., as the pioneer in that territory in the production of turpentine and rosin on a commercial scale from that tree. The U. S. Consul General at Vancouver also reported to the Department of State (Consular Reports July 3, 1920), on the operations in British Columbia of Mr. E. S. Oliver, an English industrial chemist, and associates, stating that "Mr. Oliver, who has in the past conducted investigations in Mexico and Central America, and in the forests of Russia, Sweden, Germany and the Mediterranean countries, states that the greatest potential source of turpentine and resin chemicals lies in British Columbia." "Among the products obtained as a result of experiments with Douglas fir trees are turpentine, fir oils, which form the base of 'fruit' extracts used at soda fountains, medical oils, etc., and resins which make varnishes of the highest grade. Printing inks are also made from the resin. One of the most interesting products is Burgundy pitch, which, instead of being 'pitch' black, is snowy white. Its greatest value is as a white ink for use in lithographic work."

Continuing, the Consul-General stated that Mr. Oliver advised that the indus-

Boring a Small Fir Tree for Pitch.



Sections of Fir Trees Bored in 1893 (See Text for Explanation.)

try "will be a constructive one, instead of a destructive one as practiced in the southern pine forests of the United States. Every tree, no matter how small or how ill shapen, so long as it is healthy can be made revenue producing. It will help the lumber industry and will itself become the greatest single industry in the Province."

According to the American consular representative "a local concern has started operations in Cortez Island, at the mouth of Campbell River, about 60 miles from Vancouver, where 20 men are employed. The men now engaged in the work are mostly ranchers residing in that locality, but it is the intention of the Vancouver company to put on about 200 workmen. The method of pursuing operations is to secure sap rights from private owners. It is estimated that a block of about 100 acres of Douglas fir gives about 800 barrels of pitch per year, or a total of about 40,000 gallons. The rancher is also provided with employment if he so desires, at $5 a day. The majority of the landowners in the Cortez Island and adjacent districts are holding their property for the ultimate timber wealth, but the establishment of this new industry is adding much to the value of the forests.

"The company is working on trees not less than 10 inches in diameter. Some of the larger trees are said to yield upward of 40 gallons at the first tapping. The pitch comes forth in colors varying from a bright green and deep red to a milky white. The color denotes the quality of the product, the bright green being of the highest grade. One gallon of sap produces about one-third gallon of high-grade 'turps,' while the residue is rich in valuable by-products."

In an extensive work on the "Forests of British Columbia," issued by the Canadian Commission of Conservation in 1918 (Ottawa), many references are made to the Douglas fir. From it the following information is drawn as to the tree which, if the claims are borne out by the results, may some day furnish great quantities of naval stores, although it may not be amiss to say that turpentine investigators from the South have not been swept off their feet by their personal observations up to this time:

"This species has been called by botanists Pseudotsuga taxifolia (Lam)—Britton and Pseudotsuga Douglasii (Carr), and it has even been assigned to the Genera Abies and Pinus by some of the early botanists. A great variety of common names is attached to it. In the export trade of the Pacific states it is known as the Oregon pine. In British Columbia it is, as a rule, simply called fir. Two varieties, yellow fir and red fir, are sometimes recognized. The former is the product of the most favorable sites, and is characterized by a yellowish flakey bark but, slightly furrowed. The wood of the yellow fir is lighter and softer than that of the red fir, owing to the fact that the summerwood rings are not so prominent.

"Douglas fir reaches its best development in the region directly tributary to the salt water, between the mouth of the Columbia river and Seymour narrows. In British Columbia, it occurs on the coast as far north as the head of Vancouver Island; and, though not found close to the northern coast, it reappears near the upper ends of the fiords as far north as Gardner canal. It is not reported at Ootsa Lake, Eutsuk Lake or the headwaters of Dean river, but is found along the Grand Trunk Pacific Railway to the east of Burns Lake. It extends as far north as the southern end of Tacla Lake and to Fort McLeod, and crosses to the Rocky Mountains to the foothills in Alberta.

"It thrives best on well-drained soils, where the annual precipitation is between 50 and 60 inches, and where the climate is moderate and not subject to extremes. It grows in the interior where the extremes in temperature are very great and the water supply scant: but, under these conditions, it is much smaller, and the wood is of not such good quality. It is a light-demanding species and grows best in event-aged stands, where, owing to its rapid growth, it soon becomes the predominant species. It reproduces readily when the seeds reach mineral soil and sufficient light is available; but it is at a disadvantage, as compared with hemlock and cedar, in the virgin forests, where the soil is covered with vegetable mould and is shaded by large trees. The seeds of fir have been found to retain their vitality for several years, and clear cutting and immediate slash burning are usually followed by good fir reproduction.

"With the exception of giant sequoias and redwoods of California, the Douglas fir is the largest tree on the Pacific coast. It ordinarily attains a height of from 175 to 200 feet, and a diameter of from 3 to 6 feet. Not infrequently, trees up to 250 feet in height and from 6 to 9 feet in diameter are seen. Owing to its intolerance of shade, the lower branches soon die and drop off, leaving one-half to two-thirds of the bole clear and a large percentage of the wood free of knots.

"The appearance of the bark of the fir varies so greatly that, from this feature alone, it would be difficult to recognize two specimens of extreme types as belonging to the same species. On young trees, until they reach 12 to 16 inches in diameter, the bark is smooth, ashy-brown, with lighter patches and resin blisters. It resembles balsam so closely that it is sometimes mistaken for it. On large trees the bark is ordinarily 5 to 10 inches thick at the base

of the trunk, sometimes even thicker. Typically the bark is of a dark-brown colour on the outside and reddish-brown when cut into. Ordinarily it is deeply furrowed. In old age, on good sites, the furrows are not so pronounced, and the surface breaks up into flakey scales. The bark makes excellent fuel, burning readily, but more slowly than the wood.

"The foliage, when mature, is dark-green, which affords a contrast to the lighter yellowish green of the cedar. The leaves persist for seven or eight years; they are usually about an inch to an inch and one-half long, flat, soft, and as a rule, blunt pointed.

"The cones are reddish-brown and from 2 to 3 inches long. The most conspicuous feature is the three-pointed bracts which protrude from under the cone scales. The cones ripen in August and September and, while on the tree, open to shed their seeds.

"The rate of growth of the fir varies greatly with the environment. On the coast it has reached 80 feet in height and 13 to 14 inches in diameter in 50 years. In the drier regions of the interior it may attain only 14 feet in height and 3 to 4 inches in diameter in the same time. Dr. C. A. Schenck reports having measured a forty-year-old stand of fir in Washington, which carried 40 M. b. f. per acre, an average of 1,000 board feet per acre per annum.

"Douglas fir has been successfully planted in Great Britain and Continental Europe. Where the climate is not severe care should be exercised to secure stock of the coast type. In Eastern Canada and the Northeastern States the interior type will be found more hardy.

"In the virgin forests on the coast, where fir predominates, the stands usually run from 20,000 b. f. to 50,000 b. f. per acre, though frequently, on the better sites, the yield exceeds 100,000 b. f. per acre; one instance being recorded where 5,000,000 b. f. was cut from 10 acres. Single mature trees ordinarily contain from 2,000 to 5,000 b. f., but sometimes exceed 10,000 b. f. In the mountains, the fir stands usually run from 5,000 to 15,000 b. f. per acre, though in some of the more moist valleys stands are found almost equal to those on the coast. In the interior dry belt the individual fir trees usually contain from 500 to 2,000 b. f.

"Douglas fir is, perhaps, the healthiest tree in British Columbia. It does not suffer from insect pests or fungus diseases to nearly the same extent as do the hemlock and cedar. The logs are remarkably sound, even from very old trees. Owing to its intolerance of shade, however, the tendency in the virgin forests is for the fir to be replaced by hemlock and cedar."

The Legislative Assembly of the Province of British Columbia on March 12, 1920, passed a "Forest Act Amendment Act." This provides that "There is reserved to His Majesty a royalty on resin of three-quarters of one cent per gallon, eight pounds of resin being taken as equivalent to one gallon, in respect of all resin obtained from trees on lands comprised in:

(a) Any resin licence; or

"(b) Any special or other timber licence, hand-logger's licence, pulp licence, pulp leasehold, timber leasehold, or hemlock-bark lease, whether the licence, lease, or leasehold was issued or constituted before or after the enactment of this section; or

"(c) Any pre-emption record made after the enactment of this section; or

"(d) Any application for purchase of Crown lands in respect of which notice of the favourable decision of the Minister is given to the applicant after the enactment of this section; or

"(e) Any Crown grant issued after the enactment of this section, except where the title to the lands so granted is acquired by virtue of a pre-emption record made before the enactment of this section, or by virtue of an application for purchase in respect of which notice of the favourable decision of the Minister was given to the applicant before the enactment of this section, or by virtue of a contract for the disposition of the lands entered into, or a right to acquire the lands obtained before the enactment of this section.

"The Crown shall have a lien for the amount of any royalty payable under this section, upon the resin in respect of which the royalty is payable, and upon all teams, wagons, machinery, plant, and material used in obtaining the resin, and upon all resin belonging to the holder of any licence or permit under which the resin was obtained; such lien to constitute a first charge in priority to all other liens, encumbrances, or charges, and to be enforceable to the like extent and in the like manner as the lien and rights of recovery of timber royalties conferred by the provisions of this Act in that behalf, including an absolute, unconditional power to sell.

"In the case of any Crown lands which are not comprised in any pre-emption record or application to purchase, or any special or other timber licence, hand-logger's licence, pulp licence, pulp leasehold, timber leasehold, or hemlock-bark lease, the Minister may from time to time offer for sale and sell by public competition a licence to tap the trees standing on those lands for the purpose of obtaining resin, on terms and conditions prescribed by this section and by the rules made thereunder, which licence shall be known as a 'resin licence.'

"The annual rental in respect of every resin licence shall be not less than two cents per acre, in addition to the forest-protection tax.

"No resin licence shall in any way limit or affect the disposition of any lands comprised in the resin licence by pre-emption, sale,, lease, or other alienation by the Crown under any Act of the Legislature, nor in any way limit or affect the disposition of any timber on the lands comprised in the resin licence by sale, licence, or otherwise under this Act; except that during the term of the resin licence, and until a Crown grant is issued of the lands in respect of which any such alienation or disposition is made, the holder of the resin licence may continue to obtain resin under the licence from the trees on those lands so long as any trees are left standing thereon.

"Subject to the payment of royalty at the rate provided in section 11c, the Minister may grant to the holder of any special or other timber licence, hand-logger's licence, pulp licence, pulp leasehold, timber leasehold, or hemlock-bark lease a permit to tap the trees standing on the lands covered by or included in the licence, leasehold, or lease for the purpose of obtaining resin therefrom, on such terms and conditions as the Minister may prescribe.

"Where any pre-emptor is desirous of obtaining or disposing of resin from the trees standing on his pre-emption in a manner or to an extent which, except for this subsection, he is not entitled by law, the Minister may, subject to the payment of royalty at the rate provided, grant to the pre-emptor a permit to tap the trees standing on his pre-emption for the purpose of obtaining resin therefrom, on such terms and conditions as the Minister may prescribe; and the pre-emptor may thereupon obtain and dispose of the resin in accordance with the provisions of the permit.

"Where the applicant under any application for purchase of lands pursuant to any Act relating to Crown lands is desirous of obtaining or disposing of resin from the trees standing on the lands in a manner or to an extent which, except for this subsection, he is not entitled by law, the Minister may, subject to the payment of royalty at the rate provided, grant to the applicant a permit to tap the trees standing on the lands for the purpose of obtaining resin therefrom, on such terms and conditions as the Minister may prescribe; and the applicant may thereupon obtain and dispose of the resin in accordance with the provisions of the permit."

The Chief Clerk of the Forest Branch of the Department of Lands at Victoria stated at the close of August that there were several applications in hand for rosin licenses, but none had actually then been issued. Two or more naval stores concerns of the South at that time were looking into the possibilities of the Douglas fir as a naval stores source of supply and it is reasonable to suppose that the matter will be exhaustively investigated in the near future.

It is estimated that the United States originally possessed 850 million acres of timberland, of which only about 545 million acres remain. However, in spite of the methods of lumbering that have wasted so much of our original timber, the United States is still the third country of the world in respect to forest acreage, being led only by Russia and Canada. * * * In the distribution of standing timber by species in the United States the Douglas fir stands first, with 718 billion feet to its credit, followed by Southern yellow pine with 392 billion feet and Western yellow pine with 834 billion feet. One-fourth of all the standing timber in the United States is Douglas fir

THE NAVAL STORES INDUSTRY IN FRANCE

(By Ad. Genvrain & Cie, of Paris and London)

[Ad. Genvrain & Co., of Paris and London, are well known dealers in naval stores who have been interested in the industry and trade of France in these products for many years, in constant close touch with the naval stores operators of that country as well as with the handlers and consumers of their output. A number of the illustrations in the series of articles on the French industry in this book were taken especially for it through the courtesy of this house. Others were furnished by Capt. Eldredge and the U. S. Forestry Bureau.]

THE exploitation of the French pine forests is of recent date. A century ago the whole of the region occupied by the pines was a vast desert-like marshy stretch without any useful vegetation and almost without any inhabitants.

The work which first brought people there was begun at the end of the eighteenth century, and its object was to prevent the sand from the ocean encroaching on the land. At the same time it was intended to cultivate the whole of the Landes region, but, owing to the marshy state of the land, for some time only very poor results were obtained.

It was only later (1857) that a law was made decreeing for the public good the sanitation of the land by means of a drainage system of which excellent results had been shown by the experiments of Chambrelent.

The attempts at cultivation which so far had given but the most meagre results became a complete success from the moment this law was put into execution.

At the present time the systematic replanting of the trees as the old ones are cut down is carried out in various ways, and assures to the Landes district an equal and constant production.

In a general way the tapping of the trees commences towards the twenty fifth year when the trees have a circumference of about 23½ inches; meanwhile the poorer trees are cut down so as to leave only those which, from twenty-five years of age, are likely to be the most useful as pit props, telegraph poles, sleepers, planks, etc.

When the time arrives for tapping the trees, the operation is carried out in three steps:

1. The trees destined to be cut down at an early date, are bled to death, that is, several incisions are made in them in such a way that the largest quantity of gum may be obtained with the least possible delay.
2. The trees destined to be worked in the same way as the above, but not such fine ones, and which have still three or four years to grow before undergoing the treatment.
3. The trees destined to remain in place many years and which are chosen from the best formed and the most advanced. These are tapped in moderation, one incision being made annually until the quantity of gum obtained begins to decrease, or represent less profit than what would be obtainable by cutting down. They are then bled to death before being cut down.

The processes by which the gum is collected are described further on.

The pine forests are often the prey of fire. To limit as far as possible such damage, recourse is had to preventative means, of which the principal are "Clearings" (pare-feu) and "Clearing away all brushwood", (debroussaillement).

The "Clearings" (pare-feu) consist of wide alleys dividing the forest in such a way as to leave clearings on every side and thus isolating the fire.

The Shaded Section in the Southwestern Section is the Turpentine Producing Territory of France.

A French Turpentine Plantation.

These alleys are made straight and at right angles to each other, and the efficacy of same depending on the nudity of the soil, precautions are taken to prevent any growth of vegetation on same.

"Clearing away all brushwood and undergrowth" (debroussaillement) explains itself, but necessitates a lot of work, and is not general.

Beyond these precautions any fire is fought by all the means that exist in the district in which it starts, and by the mutual assistance of all the inhabitants.

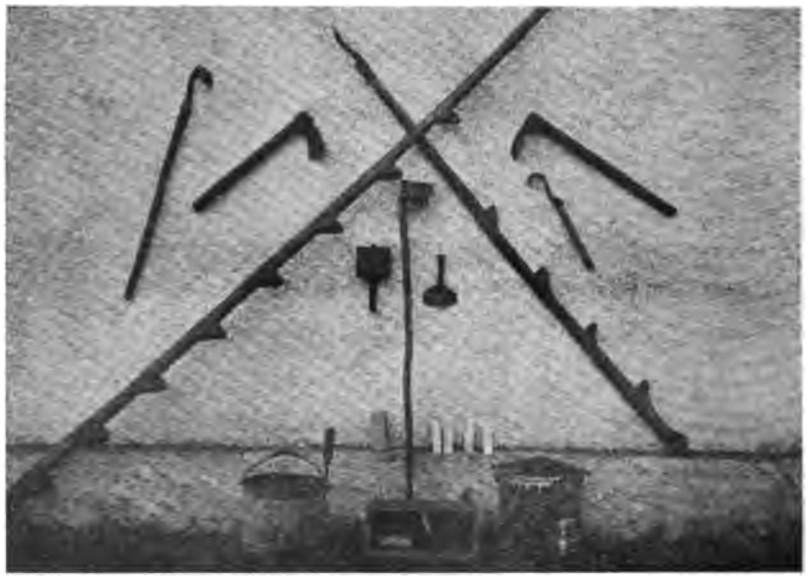
The gum is tapped generally in France today by what is known as "Hughes System," that being the name of the inventor, and consists of collecting in an earthenware pot, holding slightly less than a pint, the gum which runs from an incision made in the tree; this incision is called in France "la quarre." The first incision is made about 8 inches long, by 4 inches wide, and rather over one-third of an inch deep in the sapwood. Once a week the incision is cleaned and slightly lengthened, in such a manner that at the end of the season it attains a length of 21½ inches whilst the width remains unaltered. Whilst attending to this operation, which is called "le piquage," the workman takes out any water or impurities that may have collected in the pot.

The pot is fixed at the foot of the incision by a piece of zinc which at the same time forms a gutter over the pot for the gum to run down, and it is supported from below by a simple nail fixed into the tree.

At the commencement of the year the pots fill in about four to five weeks, but as the weather becomes warmer they fill more rapidly.

When the pots are full they are emptied into barrels which are centralised and later taken by mules to the works, this being done seven or eight times a year. The first, second, and third collections give the greatest proportion of turpentine and extra pale qualities of rosin. The following collections gradually deteriorate until the last gives chiefly F, G, and very little turpentine. The last collection of all is chiefly made up of gum that has dried up during the year on the incision instead of running into the pot. This product or scrape called "le barras" in French, on account of oxidization and evaporation, gives a large proportion of dark rosins.

At the commencement of each season the workman makes a new incision above the preceding one, which is abandoned, and raises the pot so that the gum has not so far to run. This con-



The Tools of the French Industry.

Hanging Cups on a French Turpentine Farm.

tinues each year till the incision reaches to a height of about eight feet from the foot of the tree.

The tree is then left to rest for two or three years, before it is operated on again on the opposite side, and successively on the two other sides in the same way.

This system is that applied to the trees named "Pins de Place," destined to remain in position for many years, and is called "gemmage a vie." When the time comes to cut down these "Pins de Place" they are bled to death, that is several incisions are made simultaneously as already explained.

Other systems have been tried with the object of obtaining a better result from the pines, but they have not become general, largely due to the opposition of the proprietors of the forests, as well as by the workmen who will not easily change the old routine. These experiments had chiefly for their object:

1. To prevent the gum running to the ground when rain makes the pot overflow, this particularly at the commencement of the season when the gum, rich in turpentine, is still of a density inferior to that of water and floats on the top.

2. To protect the contents of the pot from dust and rubbish that may mix with the gum and spoil its quality.

WOOD: With regard to wood, the pines are exploited for the making of pit props, telegraph poles, shipmasts, parquet, packing cases, firewood, railway sleepers, charcoal, etc.

There are for this purpose sawmills, and also mobile installations, the latter belonging either to the wood merchants who buy the trees standing, or to small companies working by contract.

RESINOUS PRODUCTS: As stated above, the workman, having at certain intervals collected the contents of the pots into barrels, takes these to the works for the account of the proprietor, or sometimes deposits the gum into reservoirs situated in the forest where certain proprietors store it. The vehicle used for transporting the gum is fashioned in the shape of a large barrel on account of the uneven state of the ground and can be completely reversed without losing any of its contents. This barrel is on wheels and is drawn by mules.

Usually each works has its regular suppliers from amongst the local proprietors, and the gum is brought to the works several times a year as stated above. The works pay cash at the rate paid for the gum belonging to the nearest commune. The communes of the Landes are themselves proprietors of a part of the forests which they exploit for their own account, and their crop is sold to the highest bidder. The price thus obtained at each collection serves as a basis for the transactions between the neighboring proprietors and the works.

The workman, whether he works for a proprietor or the commune, receives as salary half of the value of the gum collected by him in the fixed area of which he is in charge.

There are in the Landes one hundred and twenty works more or less modern, but they do not all employ the same means of distillation.

The three principal processes employed are:

1. CRUDE DISTILLATION (Distillation a Cru): This is the simplest and most primitive method. It consists of the heating by open fire of the receptacle into which the gum has been poured just as it arrives from the forest. The result is the best as regards quantity, but the quality is not so good. The turpentine is satisfactory but the better pale rosins cannot be obtained by this process.

2. STEAM DISTILLATION (Distillation a la Vapeur): This process differs from the above in this sense, that the necessary temperature is obtained either by hot water under pressure (l'eau chaude sous pression), or by steam under high pressure (vapeur surchauffee), or by saturated vapeur (vapeur saturee). The boiler also serves for reheating and filtering the gum and tends to improve the colour of the rosin.

3. DISTILLATION BY VACUUM (Distillation dans le Vide): This is an improvement on the preceding process.

Chipping in France. The Heavy Bark is Scraped from Above the Face in Advance of the Chipping.

Its principal advantage is a great economy in fuel and labor. It further gives the best pale rosins.

The turpentine, as distilled, runs into reservoirs from whence the manufacturer sends it direct to his buyers in tank-wagons belonging to the latter.

With regard to the rosin it is run into barrels containing about 400 kilos (a little less than 8 cwts.) which are made at the works, or the liquid, still hot, is poured into large shallow trays and exposed to the sun with the object of bleaching it. This is only, however, done with rosin that is already pretty pale, and not for instance, with anything inferior to N and WG, except in very rare instances when the difference in price makes it worth while. The darker the rosin the less tendency it has to bleach in the sun, and common rosin would not be affected at all.

TRADE: Sometimes the producer sells his produce direct to the user, either in France or elsewhere, but generally the trade is in the hands of merchants having warehouses at the ports of Bordeaux and Bayonne, agents abroad and in the large towns of France, and an organization which enables them to supply the demand of their customers whatever the quantities or qualities asked for.

With regard to the turpentine, the producer being unable to procure turpentine barrels easily, usually, as already stated, sends it away in tank-wagons. However, this means of transport is not suitable for all buyers, and therefore the trade is chiefly in the hands of merchants having tank-wagons and stores in the localities where it is used, and at the ports. Some large users, however, have tank-wagons of their own and are thus enabled to buy direct from the producers.

With regard to rosin, many producers prefer to sell, without stipulating a given quantity of any grade, the whole of their output, and this is done solely on the reputation of their works. Of course, these can only deal with buyers prepared to accept indefinite qualities and quantities.

On the other hand there are producers who find it to their interest to deal through the merchants and sell week by week on the Saturday market at Dax and the Monday market at Bordeaux, at which places it is customary for them to meet the dealers and the various other persons interested in these articles.

The annual French production before the war was about 20,000 tons of turpentine, and 80,000 tons of rosin. About half of these quantities were exported. France supplied Germany, England, Switzerland, and Austria chiefly, with both rosin and turpentine. Also large quantities went to Russia. Germany was the principal buyer of extra pales.

Today it is estimated that in 1920 the production will be greater than before the war on account of the high prices which will incite the producers and workmen to produce as much as possible. A good number of trees which in normal times would have been neglected have been tapped, and others prematurely.

The result is that allowing for parts of the forests which have disappeared during the war, one can count on a production for 1920 of 25,000 tons of turpentine (155,000 barrels turpentine of 50 gallons), and 90,000 to 100,000 tons of rosin (405,000 to 450,000 barrels rosin of 500 lbs.) (See report of U. S. Consul Jaeckel in this series of articles on French production for 1914-1920.)

The markets buying are no longer the same. Germany is not taking the extra pales and the result is making itself felt with regard to these grades. Russia is likewise out of it; but on the other hand other markets are buying and appear to be making up the deficit, especially in view of the fact that American exports are likely to compensate, by their shortage, for what France may have in excess.

THE NAVAL STORES MARKETS OF FRANCE

(By the Editor of Le Bulletin des Halles, Bourses et Marches, Paris, F rance.)

["Le Bulletin des Halles" is a daily business journal of Paris, founded in 1846, which furnishes its readers with the daily market reports of the world, including naval stores among the many commodities covered in its service. It pays especial attention to pine tree products, but has a broad scope of information relative to agriculture, commerce and industries, etc.]

Removing the Gum from the Cup in the French Process.

THE MAIN market for naval stores, in France, is the Dax market. It is held in that town every Saturday, in the "Cafe de la Bourse" (the place having no Exchange to boast of), from 10 a. m. till about 3:30 p. m. The syndicate of manufacturers fixes there a quotation for the crude gemmae, or gum, per barrel of 340 liters (a litre is equivalent to .26417 gallon), the so-called "grosse barrique." This price serves as a basis for the refiners to buy their gums, as well as to hand in their tenders for the several communal auctions in the Landes department (the so-called communal gums.) The war has brought about in this market, as it has in many others, numerous changes. The quotations for refined products have been dropped altogether, and the trade takes as a basis the average price of business passed during the session.

The following will be found useful in reading the quotations:

TURPENTINE: Prices quoted per 100 kilos, in the buyer's cistern, ex-station Landes Department, cash down, no discount, epoch of delivery to be agreed upon (a kilo is equivalent to 2.2046 lbs.)

DRY PRODUCTS, (Rosins): Prices quoted per 100 kilos, including barrels, the tare to be calculated at the fixed rate of 7% of gross weight, ex-car Landes, payment for cash, or at 40 days, 30 days or any agreed date, according to convenience in transportation means.

Face on a French Tree about Midway of Second Season. This Tree Has Been Worked for Seventeen Years. This is the Fifth Face to be Started.

Removing Scrape at the End of Third Season on This Face of a French Tree.

(At this writing, the situation has bettered itself in this regard and the payment for cash is not a rarity.) Sometimes the seller insists upon payment on monied invoice, whether the goods have been delivered or not.

In Bordeaux a market takes place every Monday, at the Exchange; it follows the tendencies given by the Dax market. Business hours from 2:30 p. m. till about 4:30. This market is mainly the resort of business men and manufacturers of the Gironde district. There is established a quotation for the gemmae which serves for the region roundabout (Gironde, Charente); prices are quoted in francs per liter. No quotation is established for the manufactured product; the average price noted during the session serves as a basis. These prices must be understood in the following manner:

TURPENTINE SPIRITS: Per 100 kilos bulk, delivered to the buyer's store in Bordeaux (transportation takes place either by rail, mule, or motor trucks.) Payment without discount for cash.

DRY PRODUCTS: Per 100 kilos in barrels, the tare to be calculated at the fixed rate of 7%, delivered in the buyer's store in Bordeaux. Payment without discount for cash.

The Bordeaux market has interest principally for the Gironde region.

Besides these two weekly markets, a certain number of "fairs" are held each year:

In Villadrant (Gironde) two fairs concerning the naval stores (April-May).

In Labouheyre (Landes) three fairs (formerly four) whose main interest centers in the naval stores (March, June, September). The fair held in June is the principal one.

There is in Paris no exchange that fixes prices for pine products. All quotations are fixed by brokers or big houses once a week in their meeting and the prices fixed are nothing but nominal ones. In fact, each house dealing in naval stores in Paris has its own mark and it is from the standard price fixed each week that the price of the mark is made in relation with it.

All the houses in Paris dealing in naval stores have branches or representatives in Dax or Bordeaux, or are owners of forests in that part of France.

The following notes are extracts from memoranda gathered during a number of years and kept up to date by us:

The "Pinadas" (pines) of Gascony cover an area of more than a million hectares, 516,608 in the Landes department, 461,915 in the Gironde and 100,000 in the Lot-et-Garonne. A hectare is equivalent to 2.471 acres, hence the total of above 750,000 hectares is approximately 1,900,000 acres.

The crop is made between March and October. Exports are made from Bordeaux and Bayonne.

The pinus maritima, the "Golden Tree" of the Landes, is also grown in the Charente Department.

One hectare of cultivated land yields about a "barrique" (340 liters) of gemmae, when the trees have reached 1 meter to 1.10 meter circumference, measured at the height of a man's shoulder. This stage of development is reached when the tree is from 20 to 70 years old. Rest periods must of course be given the trees.

The gum distillation processes in France are very numerous. The so-called "raw" and "compound," the steam and vacuum processes, are the principal ones one meets. The Landes Department possesses 115 plants for gum treatment, with a total of 400 to 500 employees. The products are turpentine spirits, colophany, and the different varieties of pitch, rosin, pyrogenated oils.

The entire southwestern production has been estimated at 25 million kilos turps and 100 million kilos dry products.

The southeast of France produces also some little naval stores; and so does Corsica. But neither of these regions can be said to play a role on the market conditions.

In Paris, turps are sold either by the barrel of from 160 to 165 kilos, or by the cistern or car-tank from 10,000 to 15,000 kilos. Dry products barrels will weigh up to 400 kilos.

It is at the present moment utterly impossible to give information concerning trading prospects, the exchange variations and transportation rates having played havoc with all established rules and customs. The same applies to the pine wood, which goes to make telegraphic poles or mine standards, beams,

Working a French Pine Twenty Feet from the Ground.

Typical Scene Showing Three Phases of Working Trees in France.

sleepers and planks. The city of Paris absorbs a large quantity of this wood for street paving purposes. The devastated regions of Northern France also need big supplies of pine wood to build temporary houses.

The production of the Landes Department is of 374,000 tons yearly. It does an important export trade with England (mine standards) and with Spain. Recent government experiments have set forth the excellent qualities of this wood. The cork tree is also a familiar sight in the Landes region.

EXPORT: France exports nearly one-half of its production of pine products. The ups and downs of English and American prices sometimes have a very decided action on French prices. At the present moment the rate of exchange is likewise a very important factor to depress or boost prices.

French naval stores never go to the United States and are only able to match American products in London when American turpentine is correspondingly high.

PLANTATIONS OF PINES IN FRANCE: The cost of planting used to be before the war 30 to 40 francs (6 to 8 dollars) per hectare (2.471 acres), each tree being at a distance of four metres (13 feet) from any other. It is very much higher now and depends on the soil quality.

The destruction of weeds or bushes is made every five or six years. The syndicate expends between 0.30 and 1.20 francs for the survey and defense against fires. Other small work costs every year 4.50 to 6 francs per hectare. Warders for survey against robbery represent a cost of 3 to 6 francs per year and per hectare.

The pines begin to produce at the age of twenty years. Between 170 and 200 pines (to the hectare) are to be scorched and they give between 150 and 250 litres (39½ to 65 gallons) per year. Between 24 and 28 years of age, they are cut and sold as wood.

Other pines of 22 to 34 years are scorched and they give 170 to 220 litres (45 to 58 gallons) per year. At 34 years they are cut and sold as wood.

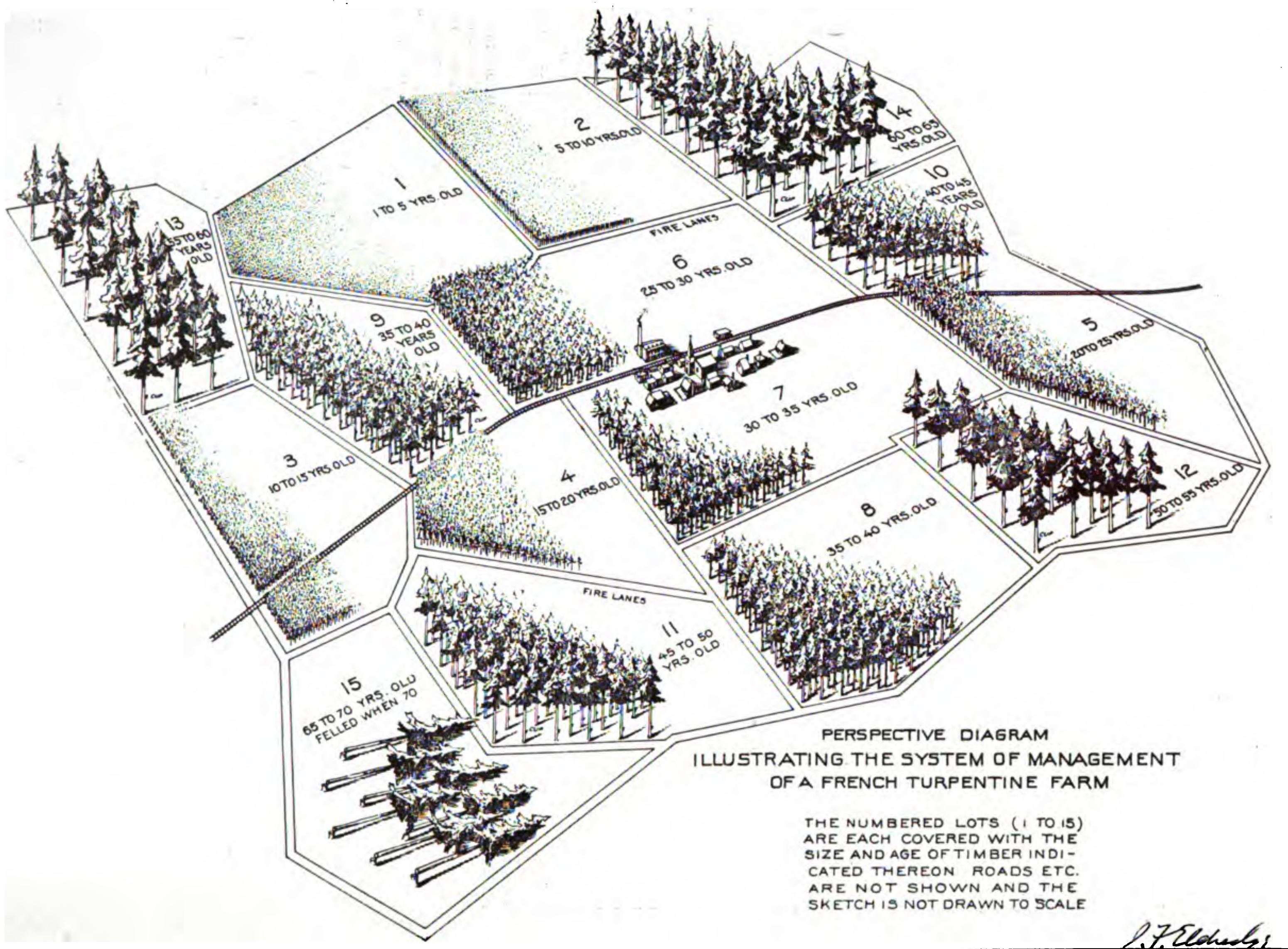
Other trees between 30 and 42 years are scorched and they number about seventy to eighty trees. Trees value is now from 10 to 80 francs a piece.

In all, the production of an hectare will never exceed one barrel of 340 litres (crude stuff) per year. (Approximately 90 gallons to 2½ acres.)

The following are the official data concerning our foreign trade in recent years:

Total exports naval stores (French and foreign goods): 1919, 525,643 quintaux (1 quintal equals 100 kilos); 1918, 214,694 quintaux; 1917, 276,893 quintaux.

Total exports French naval stores: 1919, 518,010 quintaux (value 38,851,000 francs); 1918, 176,206 quintaux (13,251,000 francs); 1917, 272,623 quintaux (16,657,000 francs).



PERSPECTIVE DIAGRAM
ILLUSTRATING THE SYSTEM OF MANAGEMENT
OF A FRENCH TURPENTINE FARM

THE NUMBERED LOTS (1 TO 15) ARE EACH COVERED WITH THE SIZE AND AGE OF TIMBER INDICATED THEREON. ROADS ETC. ARE NOT SHOWN AND THE SKETCH IS NOT DRAWN TO SCALE

HOW THE FRENCH TURPENTINE SYSTEM LOOKED TO AN AMERICAN

(By I. F. Eldredge, Captain Engineers R. C., Assistant District Forester, United States Forest Service.)

[Capt. I. F. Eldredge is at present Chief of the Office of Management in the eastern district of the U. S. Forest Service. His office has general supervision over the management and sale of the timber, turpentine leases, and other forest resources of the fourteen National Forests east of the Mississippi River. He is a graduate of the Biltmore Forest School and has been fifteen years in the Forest Service, during eight years of which he was stationed at Pensacola, Florida, as supervisor in charge of the Florida National Forest. It was during this assignment that Captain Eldredge became familiar with the turpentine industry, since the chief activity of the Florida National Forest is the leasing of turpentine privileges. Besides inaugurating the system of turpentining now required by the Government in all of its leases, he initiated and carried on a number of experiments in the use of different kinds of cups and cupping systems, as well as different methods of chipping. During the World War, Captain Eldredge was in command of engineer troops in France and operated in the heart of the French turpentine forests in the Department of the Landes, bringing him into direct touch with the permanent turpentining industry of that country and enabling him to study its essential points in comparison with the American methods. While it is not probable that the French system will be adopted in its entirety in the United States, some modification of it may become the practice of the industry in the Southern States. Captain Eldredge's statement of facts and his opinions are accordingly very timely and worthy of careful consideration.]

Women Collecting the Crude Gum in France.

IN the summer of 1917, the writer, fresh from eight years of more or less intimate contact in Florida with all phases of the American naval stores industry, was sent to France with engineer troops and was stationed in the famous Landes region, the center of the naval stores industry of that country. Although the opportunity to become acquainted with the French system of turpentining was excellent, the press of army duties precluded anything in the nature of a detailed study or investigation and the following observations will, no doubt, be found lacking in accurate detail in many places.

The turpentine tree of France is the so-called "maritime pine" (Pinus pinaster). It is found mainly in the sandy regions along the coast bordering the Gulf of Gascogne and along the Mediterranean. In appearance it is halfway between a longleaf and a sand pine, if that can be imagined. The forests from which the great bulk of naval stores in France is obtained cover about two million acres of land and are situated in a solid unbroken body in the Landes, a stretch of low, flat, sandy lands lying between Bordeaux and Bayonne. This region is a reclaimed desert which for thousands of years lay surrounded by densely populated fertile lands, defying all efforts of an ingenious people to convert it to agricultural uses. It was not until it was realized that the soil is not agricultural and is adapted solely to the growth of forests that any real progress was made in the development of the Landes. While the work of reforestation was started about 100 years ago, it was only when the world's supply of naval stores was withheld through the blockading of the southern ports during the Civil War that the possibilities of the region were appreciated and the necessary impetus given to reforestation work to bring about the establishment of the present magnificent forests.

The naval stores industry in France, while much younger than ours, has reached a state of refinement far beyond anything that we have dreamed

Collecting the Scrape Crop in France.

of in this country, because it has developed along scientific lines. The outstanding features of the French industry are:

1. A system of management which makes their forests self-perpetuating and allows continuous operation.
2. A process of extraction which permits working a tree for as long as 30 years during a period of 50 years.
3. The almost total absence of loss in standing timber and the very complete and profitable utilization of all timber after turpentining is abandoned.
4. The existence of a network of industrial railroads and splendid macadamized highways reaching every part of the forests.
5. The permanent and substantial construction of the distillation plants and related buildings the comfortable homes and attractive villages.
6. The stability, sufficiency, and contentment of the labor used in the turpentine orchards.

The French system of management is the gradual growth of many years of experience and is now as well understood and as carefully followed by the French operators as is the method of planting cotton in this country. The accompanying sketch shows, somewhat

Pouring the Gum Into Barrels for Transportation to the Distillery.

Turpentining to Death in France. This Tree Will be Worked with as Many Faces as It Can Stand for Four or Five Years and Then Felled.

Hauling Crude Gum From the Woods.

diagramatically, the layout of a French turpentine farm. In this case the territory tributary to the still has 15 lots, or parcelles, of about the same acreage. The size of the timber runs all the way from seedlings up to fully matured sawtimber, each size of timber on a separate lot. This disposition of timber by ages or sizes was obtained in the first place by planting but is continued by natural reseeding, planting now being necessary only in the event that fire destroys the young growth.

The system of cupping and chipping employed allows the operator to start working his trees when they are 25 to 30 years old and to continue cupping and chipping them, with an interval of rest of 2 to 3 years every 4 or 5 years, until the tree is 70 years old, when it is cut for sawtimber. Consequently, on the turpentine farm pictured here, the operator would be cupping and chipping all of lots 6 to 14 inclusive. Lots 1 to 5, inclusive, would be too small for regular working, and lot 15 would be turned over to the loggers and made ready for the second growth. It is evident that every 4 or 5 years one of the lots is entirely worked out and is turned over to the loggers; at the same time another lot reaches workable size and is cupped and brought under operation. Thus, this operator would always have 9 lots under operation or enjoying a temporary rest, 5 lots of young timber growing and awaiting their turn, and one lot being cut over and reseeded. Many timber owners rest their trees every 4 years instead of every 5, but the general principle remains the same.

Such a layout as is here described is called a "series." Although all turpentine farms are not so fortunate as to have an equal area of each size of timber or to have an unbroken series of lots, the principles of management used are based upon such an ideal and every operator is constantly striving, by the purchase of outlying lots, by planting, or by delayed or premature cutting, to bring his place into such a condition.

The method of chipping is the same throughout the region and is as follows: The face is started at the bottom of the tree and is extended up the trunk little by little as the chipping proceeds. The chipping is done with an instrument which looks somewhat like a carpenter's foot adze with the blade twisted a bit to one side. The face is not wider than 3½ inches and is about ½ inch deep in the center coming out to a feather edge on the sides. There is no streak like ours; the new wood is taken off in the form of very thin chips from a space at the top of the face about as large as the palm of a man's hand. After 4 or 5 years of chipping the face is commonly about 11 feet high. The width of the face is grad-

Transporting Turpentine From the French Distillery to the Railroad Station.

Pulling a High Tree in France. This Also Illustrates Another Form of "Turpentining to Death" This Tree Will be Worked with Two Faces for Four or Five Years, Then Removed to Thin Out the Stand. Notice That the Larger Tree to the Right is Not Being Worked. It Is Being Saved to Form the "Regular" Working.

ually reduced as it proceeds up the tree.

The chipping season is about the same as ours and the faces are chipped every 5 days except during the months of June and July, when chipping is done every 4 or 5 days to take advantage of the hot weather, which increases the productivity of the tree. The cup used is a clay vessel something like a Herty clay cup, but is smaller at the bottom and larger at the top with a smaller capacity. It is glazed inside and is substantially made. In use it sits on a nail, being held in place at the top by the lip of the zinc gutter, which is driven into a shallow cut with a special tool. The accompanying pictures show something of the cups, gutters, and the chipping.

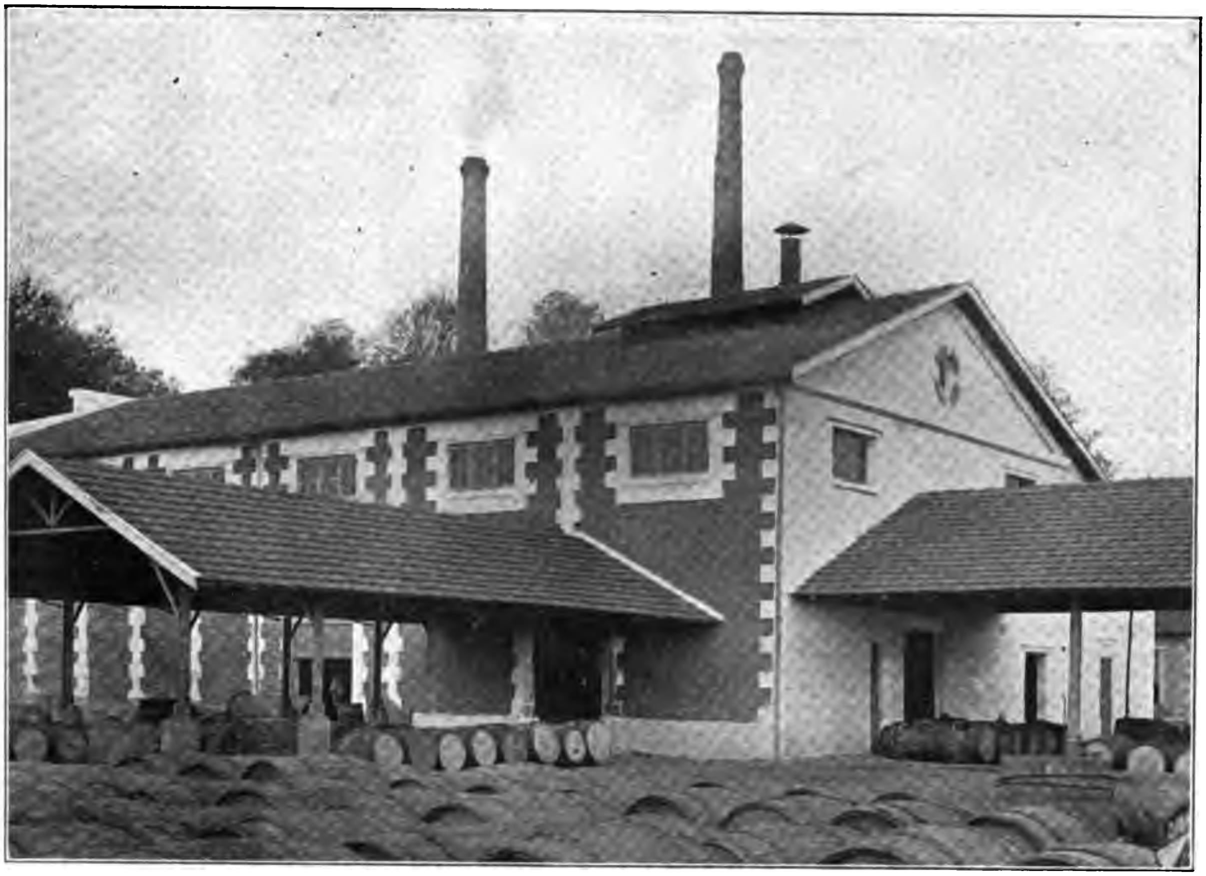
The cups are emptied or "dipped" every 5 to 7 chippings, oftener during midsummer when the flow of gum is more rapid. The scrape is taken off in the fall after the first cool weather, as with us.

After 4 or 5 years (5 years in government forests and 4 generally in private forests) the cup is removed and the tree is allowed to rest from 2 to 3 years (5 years on government forests). After the period of rest, during which the tree starts healing over the wound caused by the first face, the second working is begun. Assuming that the first face was on the eastern side of the tree, the second face would be started at the southwest corner of the tree, and would receive 4 or 5 years of working and then be rested; the third face would be made on the north side of the tree, worked, and then rested; the fourth face would be placed at the southeast corner; the fifth at the west; the sixth at the northeast; the seventh at the south; and the eighth at the northwest. The spacing of faces insures that each new face will be started on that part of the tree least affected by recent wounds.

The maritime pine is naturally a rapid grower and by the time the progress of the working has brought the faces around to the side of the tree where the first face was made, it has entirely covered the old face with new wood. The narrowness of the face and the nature of the chipping assist materially in this rapid and continuous healing over of the old faces. All fire is religiously kept out of the woods and dying or diseased trees are removed and sold as fast as they are discovered, so that the timber is kept always in a state of vigorous health.

Since the cupping operation is started on very young timber of small diameter (trees 25 to 30 years old and from 8 to 10 inches in diameter) only one cup is hung at a time, until the last three or four periods when two faces are often worked simultaneously. While there is no obstacle to the continued operation for a longer period, the market for sawtimber is usually so good that most timber owners quit chipping and throw their timber over to the loggers when it reaches 70 to 75 years of age. By this time the trees have been worked for a period of perhaps 45 years, during which time the trees were chipped probably 28 years and rested 17. There is no cut-and-dried rule as to when the timber will be turned out; the time depends upon the relative prices for naval stores and sawtimber.

During the last period of chipping, just before the trees are to be felled, a great effort is made to get out every remaining drop of gum. Cups are hung and faces started in every available place. The writer has seen as many as 11 cups hung on one tree during the "turpentining to death," as it is called. This destructive "gemmage a mort" is also used extensively during the ten-year period that precedes the starting of the regular working. At this time the trees are from 15 to 20 years old and stand very thickly per acre. It is the practice then to cut at least half of these trees in order to force the remaining stand to a rapid diameter growth and to allow for a considerable development of the crown of the trees. The trees to be removed are chipped for 4 or 5 years and are then cut and sold for mine props, posts and for fuel wood. The financial return from this thinning out process is considerable, and the opera-



One of the French Turpentine Distilleries in the Landes.

tion tends to keep up the output of gum which might otherwise fluctuate because of the periodic resting of the more mature crops.

The matter of yield is an interesting one to an American "tar heel." It is a rather difficult problem in arithmetic to convert the French statistics into such form as to make them comparable with ours, because of the difference in measures used in the two countries. To begin with, there is a wide variation of yield due to inequalities of production in different forests. It depends upon location, age, method of distilling, skill of the operator, quality and age of the faces, and climatic conditions. Taking all of these factors into consideration it may be said that, under careful management, a turpentine farm having all ages of timber represented will yield from 100 to 150 barrels of gum (50-gallon capacity) per crop of 10,000 cups per annum, from which from 20 to 30 casks of spirits (50 gallons) and 70 to 110 barrels of rosin would be obtained.

The distilling plants in general use are permanent affairs of brick, steel, or concrete, using the most modern form of steam distillation. The process is the same as ours in principle, but results in

Interior View of Messrs. Dupis' Naval Stores Plant at Biscaroose, One of the Most Modern Works in the Landes District.

Type of Apparatus Used in Crude Distillation (Over the Fire) in France.

Tank Showing How the Separation of the Water from the Turpentine After Leaving the Still Takes Place by the Difference in Density.

the extraction of a larger percentage of spirits and in the manufacture of higher grades of rosin. The distillation plants are operated the year round, having tanks available for the storage of the gum to run them over winter. As a rule the capacity of these plants is sufficient to take care of a considerable custom trade as well as the products of the owner's forest. An interesting feature is the bleaching of the rosin in order to raise its grade. The rosin is run while hot into shallow galvanized pans which are set out in the sun to bleach. The accompanying picture shows a bleaching yard.

The average turpentine farm is made accessible in all its parts by a splendid system of roads. The main highways are maintained by the state and counties and are macadamized or paved; the secondary roads are usually very short and are maintained by the operator. The still is nearly always located on a main or branch line standard gauge railroad and usually near a village which depends upon local forest products for its livelihood. These little villages which in a way correspond to our turpentine "quarters" are quite attractive. The houses are of stone, brick, or cement, roofed with tiles, and even the most remote community has its brick schoolhouse, its imposing Catholic church, a sawmill and wood yard, and numerous stores, cafes and inns. Farming in this region is distinctly a small affair; usually little is attempted beyond a vegetable garden, a few grape vines, and perhaps a little in the way of a forage crop. The forest is practically the sole source of income. Even during the trying war period of 1917-1918 the turpentine region of France exhibited greater evidence of prosperity and contentment than did the richer agricultural regions to the east of it in the Midi.

The labor of the turpentine woods is steady, efficient, and contented, with a very warm and personal interest in the welfare of the industry. As a consequence, there is no evidence of that frequent itch to move so prevalent among the "hands" of the American woods or that equally common habit of soldiering on the job. The French turpentiner has been brought up in the business. He is not only an expert in the art of gathering the product, he is a practical forester to boot, and is skilled in the science of growing and tending the trees that produce his living. His father and his grandfather before him dedicated their lives to growing, caring for and harvesting the gum from the same crop of timber he now works and they inhabited the same comfortable little cottage. There is a first-class school nearby for his children, a church for his women folk, and a comfortable cafe where he may spend an occasional hour

with his fellow resiniers over a glass of the good red wine of the country, damning the Boche and criticising the government.

Though the production of naval stores is the principal industry, it is only a part of the activity of the land owners. From every turpentine orchard there is a constant and remunerative outgo of such forest products as mine timbers, telephone poles, fence posts, grape stakes, fuelwood and charcoal, besides, of course, a heavy production of lumber. There is no lack of demand at good prices for all these commodities, and the presence of good means of transportation and a sufficient supply of skilled labor make it highly profitable to devote considerable time and thought to their production. The sawing is usually done by small portable sawmills of from two to three thousand feet per day capacity, operated in the same manner as the threshing outfits in our farming sections. They are kept busy throughout the year moving from lot to lot, according to the needs of the timber.

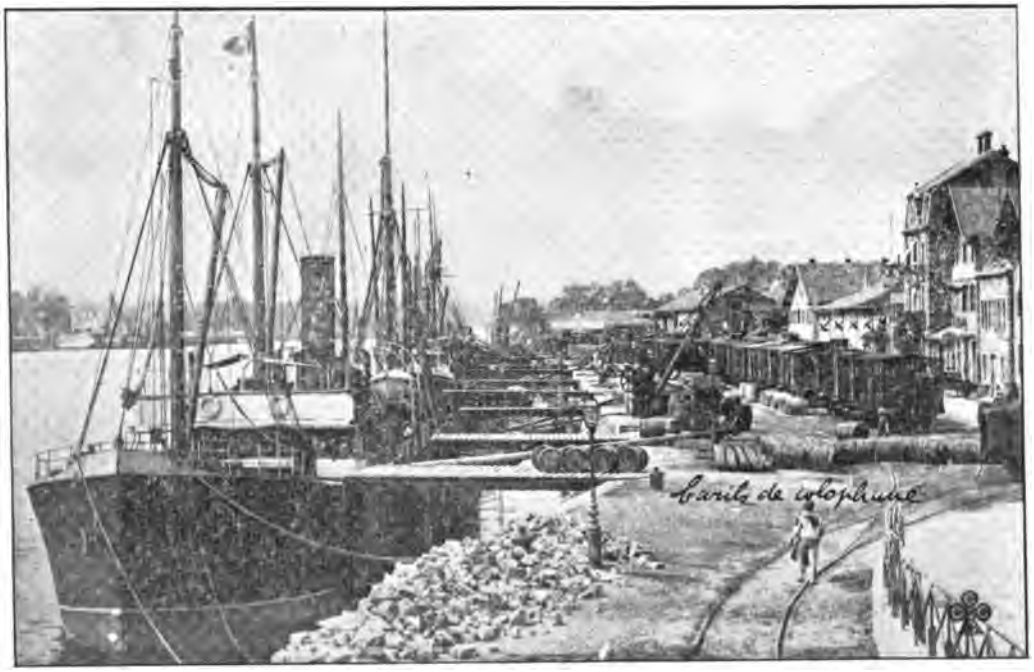
Taking it by and large, it must be admitted that the French excel us when it comes to turpentining. They have us beaten in every department of our own game. Their method of getting the gum is better than ours, because it yields a larger net return per acre in the long run; their process of distillation is better than ours, because it produces more turpentine and higher grades of rosin; their management of labor must be better than ours, for they have what we have not, a steady, sufficient and contented supply of skilled labor at a reasonable cost. They plan and manage their operations so that their forests are self-perpetuating and for the country at large the supply of naval stores is increasing, both in amount and in value. We, on the contrary, leave a blight behind us wherever we operate and work without a thought of the future of the industry. Ten years, according to the latest estimate, will see the end of the longleaf pine in the South, and with the passing of that great forest will die the American naval stores industry as we have known it.

It is too late to save the old forest; we have almost used it up; but it is not too late to start providing for the future forest. We can not hope to avoid a period of from 15 to 30 years during which the trades using naval stores will have to depend upon wood turpentine and rosin, eked out with a small amount of gum products for their domestic supply. We can greatly shorten this hiatus in supply and can eventually rejuvenate the industry by starting now to work along the following general lines:

1. Stretch out the present supply of timber to the utmost by using a conservative method of operation that will allow trees to be worked for a longer time than is now common. The system

French Rosin Bleaching Yard.

Putting Pale Rosins Into Casks from the Trays Used in Bleaching.



Shipping Rosins at Bordeaux, France.

used by the U. S. Forest Service on the Florida National Forest for the last 10 years allows of 14 years' operation during a period of 15 with a minimum loss of sawtimber value and a maximum yield of gum.

2. After the old stand is removed by the logger, see to it that a heavy second growth is obtained by natural seeding. This is easy; all that is needed is one or two seed trees per acre, total protection from fire for at least 3 years after the seed falls, and the exclusion of hogs from the woods.

3. Treat existing stands of second-growth with consideration: (a) Wait until the trees reach 8 inches in diameter before beginning regular working. Earlier working may be done on those trees which are to be removed in order to thin out the stand. (b) The faces for the regular working should not exceed six inches in width; less would be safer. (c) Do not hang more than one cup per tree. (d) Practice shallow chipping and do not go up the tree faster than 16 inches per season. (e) Rest the trees every four years. (f) Do not allow deep gashes to be made for the tins; small trees deeply gashed are easily wind thrown.

The question as to whether or not the French system is applicable, as a whole or in part, to American forests, under prevailing economic conditions, is next in order. The writer's opinion is that the French system in its entirety is not applicable to our conditions now or those of the last half century.

The essence of the French system is the grouping in series of different ages of timber so that each age class is more or less equally represented. This condition has never existed in the longleaf pine forest. Ours is a natural forest unaltered in its distribution by the hand of man, and we have had to take it as we found it. The average operator has found at least 90 per cent. of his timber to be fully matured original growth, already ripe for the saw. He did the only sensible thing, namely, extract its turpentine value and turn it over to the waiting sawmill.

In France the forest occupies only land unfit for agriculture. Our forests covered agricultural as well as non-agricultural land, and the economic pressure for the clearing of this land could not and should not have been resisted. It is true that, as we look back, we see that we could have been a little more conservative, a little less rapid in our expoitation, with profit both to ourselves and the country at large; but it is always easier to see more clearly into the past than into the future.

Now that we are nearing the end of the old forest and the old conditions and are facing a new era in the naval stores business we may well study the French system to see if any part of it may be of use in solving the knotty probem ahead.

The turpentine forests of the future in the longleaf pine belt are now in the making; the second growth that follows the removal of the original stand will form our future turpentine orchards. When the industry starts seriously to work this young timber it can and should abandon in large part the old destructive system and adapt as much as possible of the French idea to its needs. It will be desirable to assemble by purchase in one or more working units different areas of different ages of pine saplings and to lay out a plan of management along the lines illustrated in the sketch near the beginning of this article.

The young growth of pine will succumb in a very few years to the old method of cupping and chipping; it must be handled more tenderly if it is to be worked during the long period of its growth to sawtimber size. The French method of chipping is based upon the long-time working of young fast-growing timber; and while we might improve the tools used or the mechanics of the operation, the principle involved is good as it stands.

The use of steam and other refinements in distillation will come naturally, as our industry changes from the present form of many small crude stills to a few centrally located, highly organized plants doing more or less of a custom trade.

The big lesson to learn from the French is that the brains of the industry can not be expended entirely upon the extraction of the gum, its refinement, and its marketing; but an equal share of intelligence must be applied to growing and managing the forests that produce the gum.

CONSERVATIVE TURPENTINING BY THE FRENCH

THE METHODS PURSUED IN FRANCE, ALGIERS AND CORSICA

(By Theodore S. Woolsey, Jr., Consulting Forester, Formerly Lt. Colonel Engineers (Forestry) U. S. A.

[Col. Theodore S. Woolsey, Jr., forester and author, born New Haven, Conn., October 2, 1879; B. A. Yale, 1901; M. F., 1903; Assistant District Forester, U. S. Forest Service, 1908-15; Member Yale Forest School Advisory Board and Lecturer in 1912 on "Origin and Management of National Forests." Associate Editor of "Forestry Quarterly." Has made study of the forestry movement in India, Austria, parts of Germany, France, Corsica, Algiers and Tunis. Served as Lt. Colonel Engineers (Forestry) U. S. Army in World War. Author of "French Forests and Forestry in Tunisia, Algeria, Corsica," 1917, and "Studies in French Forestry." 1920, and magazine articles on forestry and kindred subjects. Col. Woolsey is a thorough, accurate and systematic writer and the merits of his work are recognized in this and foreign countries. Mr. Gifford Pinchot, so well known to all interested in the conservation of the natural resources of this country, says of Col. Woolsey: "His equipment for his task is unusually complete. His knowledge of the theory and practice of forestry in the United States is such as could result only from thorough training, followed by wide experience in the field. Through his work in the Forest Service he has seen the worst and the best of American methods of forestry and how these work out under the stress of practical, silvi cultural, financial and administrative conditions."]

AFTER more than a century of practice and experiment the French government have clearly established the fact that the turpentine business, managed along conservative lines, is a PERMANENT and yet profitable industry, which can be handled jointly with the harvesting of the mature timber for logs, piles, mine props, ties and other wood products. In France the resin usually nets more per acre per year than the sale of wood products.

The material to prove these assertions has been arranged in this article as follows:

A. Forestry in the Landes. (Southern France).

B. Algerian Forests and Forestry.

C. Pine Management in Corsica.

It should be noted, however, that the latest methods in the Landes, described hereafter, will probably be applied in Algeria.

The southern pineries of the United States, which in the past have been virtually "tapped to death," are admirably adapted for permanent production because of favorable species, soil and climate. The time for wrecking the crop as rapidly as possible, and getting the capital out, has passed except where the land can be put to a higher use, as for permanent agriculture. With higher prices, owners can afford to hold the land and work the timber as a conservative investment. The final timber crop will bring good prices, because today stumpage prices have not advanced in line with the manufactured product. It will not be long before present stumpage rates will be 50% to 100% higher. This is bound to happen when the supply of virgin timber is exhausted and forests must be raised as a crop, for we know virgin timber was originally acquired cheaply and that timber crops are expensive to raise. But the enormous value of the turpentine industry—properly managed—is that it gives the owner an intermediate yield that will help carry the whole timber investment.

As yet the best technique of turpentining probably has not been proven. Turpentine operators should therefore insist that the Forest Service (or other agencies) undertake intensive and far-reaching experiments to determine for varying conditions

(1) The best method for long term management.

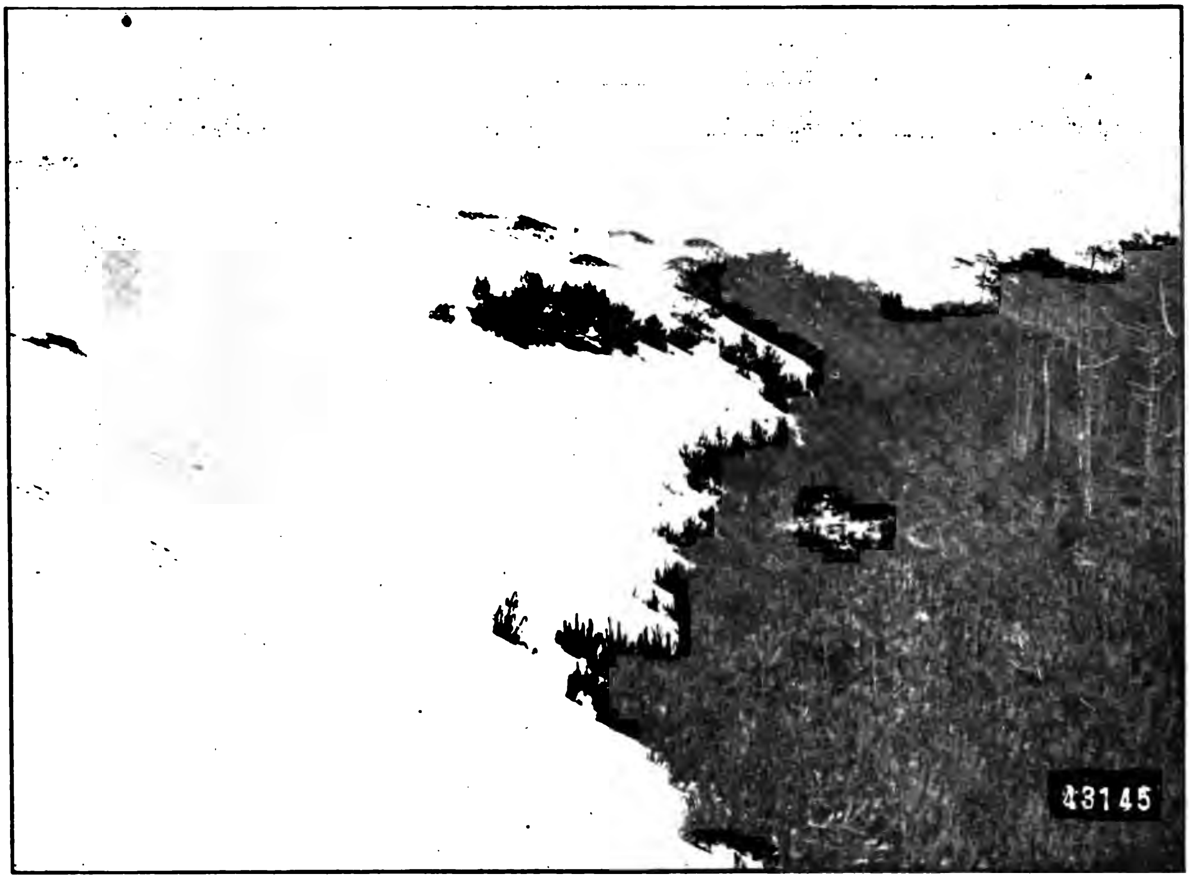
(2) The most suitable operating technique, and

(3) The fundamental economic aspects of the industry (and whether federal or state aid is necessary to give permanency to the business.)

Talk of passing laws that "no trees less than 12 or 13 inches in diameter can be tapped" is futile. Such ironclad rules would only handicap the industry, because such generalizations in "diameter cutting limits" are seldom practicable. The management and technique must be applied intelligently and according to the local silvicultural requirements. Different stands will unquestionably require varying treatment according to soil, species and growing conditions.

A—FORESTRY IN THE LANDES (Southern France)

The reclamation and forestration of the sand wastes of the Landes and Gironde between Bayonne and the Garonne River (north of Bordeaux) is perhaps the best possible illustration of the benefits of forestry to the individual, to the community, and to the nation. The individual who pioneered in sowing these sands made a handsome profit, the communities were saved from obligation by the encroachment of the sand dunes and, after being bankrupt, became rich, and lastly, France found itself sovereign of departments producing handsome revenues instead of having to furnish them assistance. Before forestration the Landes was populated with a shiftless class of "poor whites," eking out a livelihood. Today it is one of the most progressive and perhaps the most prosperous region in France, with good schools, splendid churches, and up-to-date communal buildings. Nor should the indirect benefits of this work be overlooked; a region formerly fever-stricken became healthy, and today places like Arcachon and Mimizan are health resorts both in summer and winter. Much of this land was sand, worthless for agriculture and mediocre for grazing, but nevertheless an ideal soil for the rapidly growing resin producing maritime pine. Bremontier, a great engineer and believer in forestry, was able to put the work of stabilizing the dunes and forestration on a sound basis during the years 1787 to 1817, and the problem was solved during his administration. He proved to the canny French that the work was sound financially. The parallel between the so-called sand wastes of the southern United States and the great Landes region in southern France is most striking. What has been accomplished in the Landes? In place of virtually worthless fever-stricken land the French have a balance sheet of (1) Revenue-producing forests, protected from fire; (2) a protection for such important industries as agriculture; (3) a needed supply of timber, mine props, and resin prod-



Trees Partly Covered by Shifting Sands. Large Trees Cut to Save Them from the Sand. Dune de la Grove, near Arcachon, 1911.

ucts; (4) a healthy land to live in and largely increased population.

Is it to be wondered that the French Chamber of Deputies has declared that producing forests are of paramount necessity to the nation and insist on their perpetuation, or that reforested land of this class should be exempted from taxation for thirty years? But it should be noted that the French government itself took the initiative financially and technically in the reclamation and sowing of the Landes; it blazed the trail for the private owner.

The Landes is a triangular area of some 1,977,000 acres, bounded by the Atlantic Ocean and the three rivers, Garonne, Midouze, and Adour. Three-quarters of a century ago this was mostly an unhealthy sand waste of swamp land, ponds, brush, and limited scrubby stands of maritime pine and a scattering of oak with other broad leaves. There was no system of roads and the chief industry was sheep and goat grazing. As early as 1737 the reclamation of this waste land was under consideration, but only after Chambrelent and Bremontier had shown that drainage and forestation was practicable did the State secure the law of 1857 which provided for the (a) drainage of communal land and (b) the construction of a system of roads to feed the areas drained and forested. Without these betterments the continued forestation on large scale would have been well-nigh impossible.

The drainage was finished in 1865 and cost only $172,484 to drain 468,767 acres (which had been purchased from the communal) and by 1860 $1,238,095 had been spent on roads. The communes had forested 183,000 acres by 1891 (or three-fourths the waste area they owned) and the forestation of private land had not lagged behind. It should be emphasized that today the State and communal forests under working plans occupy the poorer sands on the dunes almost entirely on a strip within four miles of the ocean. They form protection belts for the richer private forests and agricultural land which is found on the better soils inland. The system of management applies to public forests under working plans. The state and communal forests thus lie mostly in the dunes and the private forests in the level "Landes" behind the dune region.

KINDS OF DUNES (CAUSES): The maritime dunes of France are formed of sand usually drifted from the ocean or occasionally from the beds of rivers near the sea. The sand dries out on the beach or river bed at low tide and is blown inland. The normal dune is entirely a natural phenomenon, but its movement far inland is usually caused and accentuated by the destruction of bordering forests and soil cover. Huffel says: "Two kinds of dunes are found on the shores of Gascony: (1) Recent new dunes which were fixed during the last century; (2) very old (prehistoric) ones known locally by the name of mountains, which are still covered today with very old forests of pine, live-oak and cork oak. These mountains do not form(as the recent dunes do) chains of ridges separated by little ravines parallel to the shore; their confused grouping tends to show that they formed at a period when the shore line was not so remarkably straight, as it became in recent times,

Invasion of Forest by Moving Sand, Near Arcachon, France. The Trees are the Pinus Maritima.

under the action of the north-south currents."

These recent dunes may be of three kinds: (1) High dunes; (2) flat dunes; and (3) scattered dunes. Type (3) are dunes where the sand had formed irregular banks or mounds on adjacent level areas. Near the ocean the western slope (facing the sea) is 4 to 25 per cent and the eastern slope 7 to 75 per cent. Dunes are rarely more than 200 feet high, the maximum height being 292 feet in the forest of Biscarosse.

Rate of Advance.—The ends of a dune usually advance more rapidly than the center, but the ridges are about parallel to the beach and at right angles to the wind. They are irregular and form mounds of various shapes. The rate of advance inland has been estimated at from 33 to 164 feet per year, depending unquestionably on the wind and on the local topography. The average is probably 65 to 80 feet per year. There is another phenomenon connected with the dunes—the erosion of the shore line by the sea. According to my field notes:

"At la Teste, during the period 1886 to 1912, the sea has eaten away 2,231 feet of shore dunes opposite the ranger house at Gaillouneys, and at the ranger station of la Sallie 623 feet has been eroded between 1886 and 1912 (86 and 24 feet per year)."

It appears reasonably certain that the forest of Biscarosse (partly logged by the American E. F. in 1918) extended to the ocean in the 13th century. Huffel finds no reference to moving sand prior to 1580 when Montaigne wrote: "Along the ocean in Medoc my brother, le sier d'Arzac, saw his land covered with sand that the sea vomited over it . . . The inhabitants say that for some time . . . they have lost four leagues of land." A "lieve" of land was about 4.4 kilometers or 2.7 miles. If this is correct it might be argued that the destructive action of moving sand in France dates from about the year 1200 if the land was covered for 4 leagues inland (17.7 kilometers or 11 miles) at the rate of 50 meters (164 feet) a year. But this is only conjecture.

LOCAL CONDITIONS: There are fresh water ponds between the dunes from the Gironde to the Adour. Only one of these (Arcachon) is connected with the sea so as to form a bay. The average elevation of these ponds varies from 39 to 50 feet (Hourin and Lacanau) and from 6 to 19 feet (Soustons). These ponds are typical of the dune region and are responsible to a large extent for the unhealthy climate of the region prior to the systematic drainage undertaken by the State. The water hollows (lettes) between the dunes were also a source of fever. In former days there was considerable cattle, sheep and goat grazing which did a great deal of damage. According to Bert:

"After the execution of the first work, the water holes between the dunes furnished quite good drainage ground for some time. But because of the drying action of the pine, the

Sixteen-months-old Plantation of the Pinus Maritima, of Six and a Half Year Old Transplanted Trees. Photographed at Morceux, Gare.

grass production disappeared little by little; the grazing in the region of the dunes became practically of no value."

This has had an important bearing on the attitude of the communes, since the re-stocking of the sand areas often meant the physical obliteration of their grazing, and because grazing was often disastrous to the artificial forestation and had to be curtailed or forbidden altogether.

Bert says: "One of the most important problems confronting the Dune Commission was the ownership of the land. The dunes were evidently regarded as belonging to the State and the forestation was certainly alluded to at that time as belonging to the nation, to the republic, to the Government, and as royal property. If this private property, whether belonging to individuals or to communes, had been left to shift for itself it certainly would have been lost to the nation. But possibly a great deal of trouble would have been avoided if the land, then worthless, had been exappropriated at its actual sale value instead of being merely sown or planted by the State after having been abandoned by its original owners. It is significant that one or two owners in after years had their lands returned to them upon payment, with interest, of the cost of forestation. On account of the damage done by grazing, these private rights were gradually extinguished by purchase by the State."

This is similar to the policy now followed in the Alps.

The climatic conditions are favorable to the growth of maritime pine, since the extremes of temperature are 3 degrees and 23 degrees C. (37.4 degrees and 73.4 degrees F.) for cold and heat, the average rainfall 31 inches, and the average number of rainy days 200. The sole unfavorable climatic factor, which is often disastrous, but which can be alleviated by shelter belts, is the violent west winds so typical of the region. According to my field notes:

"In the vicinity of the Lacanau Ocean (forest of Lacanau) the average temperature throughout the year is 13 degrees 54′ C. (56.3 degrees F.); in summer the average is 20 degrees 48′ C. (68.9 degrees F.), and in autumn 13 degrees 32′ C. (56.3 degrees F.) There are 102 clear days annually, with a rainfall of 32 inches, coupled with frequent fogs. Violent west and southwest winds are very frequent."

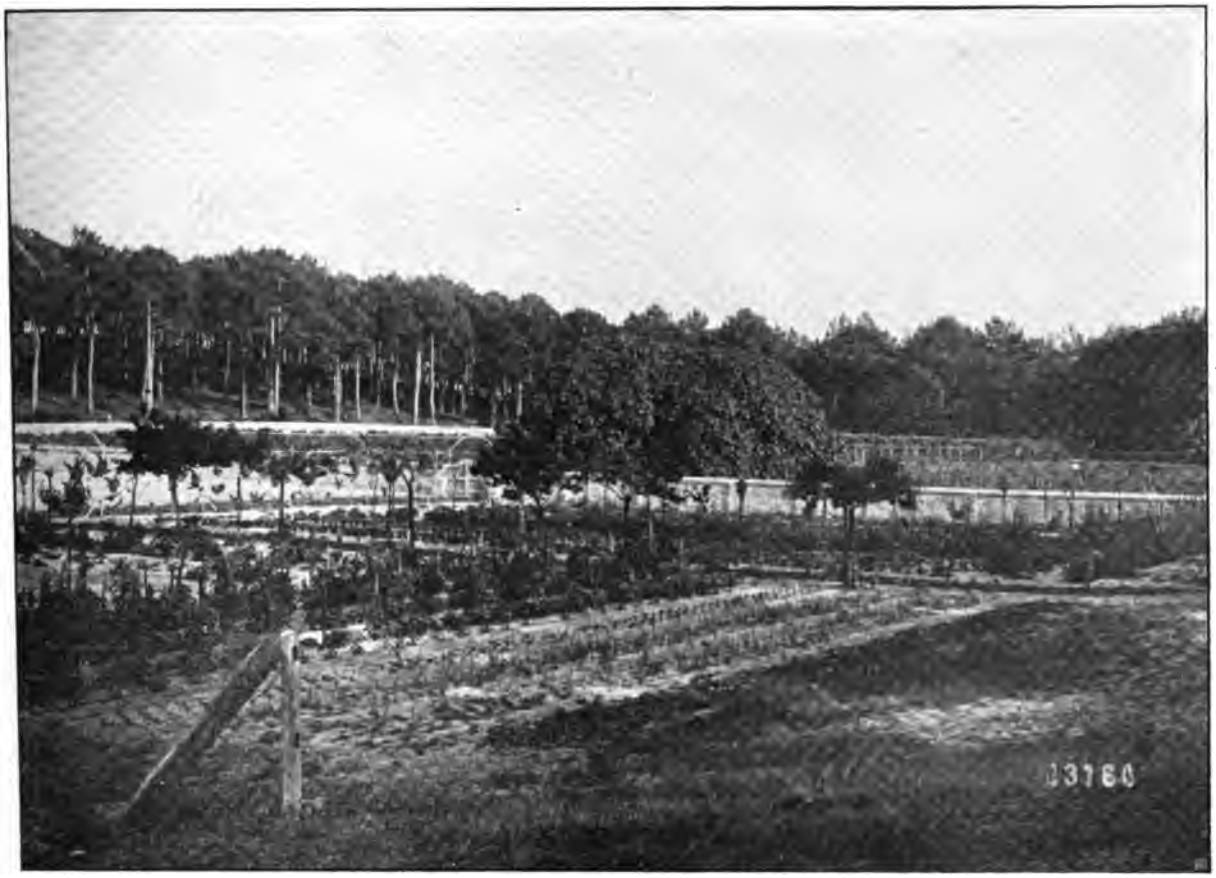
These violent winds made the fixation of the sand all the more difficult.

The main dune area is between the Gironde and Adour rivers in a strip 3 to 4 miles wide and 145 miles in length.

Statistics—Huffel says there are the following maritime dunes in France:

Area of French Dunes

Departments	Area in Acres
Nord-Somne	30,147
Main ownership, private.	
Finistere, Morbihan	3,954
Two-thirds private, one-third State ownership.	
Loire-Inf., Vendee, Charente-Inf.	33,606
State ownership.	
Gironde, Landes	252,046
One-half State, one-half private or communal ownership.	
Departments on Mediterranean	2,422
Private ownership.	
Totals for France	322,175
One-half private, one-half State ownership.	



Vineyard, Garden, Figtrees and Pine Forest Beyond, at the Villa Algerienne, near Arcachon, France. The Pines are of the Maritime Variety.

This is substantially the same area as was reported in 1822; in 1800 Bremontier had estimated it at 271,815 acres and at over 281,420 acres in 1803, while Villers had grossly overestimated the area in 1779 at 878,913 acres.

The dune areas in the Gironde and Landes are about equal. The maritime pine covers a large area outside the dunes. There is a total forest of 1,656,630 acres in the Lot et Garonne, Landes, and Gironde, divided as follows:

Ownership	Acres
Private and communal forest	1,510,549
Communal forest under state control	17,411
State forest	128,670
	1,656,630

By 1899 there were 140 miles of artificial barrier dunes in the Landes and Gironde Departments alone, the first barrier dune having been constructed in 1833.

FIXING THE SAND

Construction of Coast Dunes: It has already been seen that the ocean sand, if unchecked, drifts inland and submerges everything of value in its path. The theory of fixing or stabilizing the sand is to secure and maintain the following conditions:

Desired Conditions and Objective

Gradual shelving beach—
- To allow the waves to break their force without eroding or washing the dry sand.

Barrier dunes—
- To dam the drifting sand.

Grass or vegetable cover—
- To maintain the sand in place on and around the barrier dune.

Forest protection belt—
- To help maintain the sand in place and to protect the merchantable stands from the effects of the wind.

Forestation: It has been seen that the first step is to make sure that the protection dunes are stable, and that the first essential is to sow or plant maram grass on the slopes toward the sea about 60 to 70 feet from high tide. It is usually planted in November to February, since if planted later after the rains have ceased, it is apt to die. It is dug up from maram bunches (which are too thick) and usually six to eight shoots are planted at one place. It is cut 8 inches below the soil when collected and is dibbled 12 inches deep in the sand; it is spaced 31 inches apart near the sea and farther back 20 inches. This wider spacing near the ocean is because it needs plenty of fresh sand in order to thrive, yet inversely if it is covered with too much sand it dies out and must be replanted.

The next step is to sow the maritime pine coming back to the barrier dune.

According to a report published in 1834 the method of sowing was as follows:

"Pine seed, mixed with genista, furze, or maram grass was used for sowing in the littoral zone. It was covered with branches of genista, furze, or pine according to the locality. . . . These branches were laid flat and placed as if they were ferns. . . They were held in place on the soil with a little sand (thrown broadcast)."

The methods have remained about the same. According to the instructions of May 16, 1888, 9 pounds of pine per acre with 8 pounds of genista or

9 pounds of maram grass pure were used; in either case it took 400 faggots of 44 pounds each for the covering.

The present method of sowing takes about 18 pounds of seed per acre of maritime pine, 1.8 of genista, and 1.8 of maram grass. The tendency is to sow too densely. The correct method of sowing means scattering the seed, theoretically about 1 to 2 inches apart. The seed is then covered with branches held down by sand. The cover is absolutely essential so that the sand will not burn the seed and so that the surface will not blow. A second method is by holes 4 inches deep and 20 inches apart, covered with genista and held down by sand. A third method now used is sowing in ditches 8 inches deep and 8 inches wide. These are then covered with sand and with a light brush cover. For dry localities the best time to sow is in October and for wet localities in March. When maritime pine is occasionally planted wild stock is used. According to Boppe:

"For this purpose, instead of using pure maritime pine seed, the following mixture is sown per acre: Maritime pine, 26 pounds; furze, 2.6 pounds; genista, 2.6 pounds; maram grass, 2.6 pounds; miscellaneous seed to attract birds, 2.6 pounds. This formula is used in the Coubre Dune. In the Landes practice the maritime pine is reduced to 9 pounds per acre, while the genista is increased to 8 and the maram grass to 3.5 pounds.

The pine, the genista, and the furze come up simultaneously, and it is usually noted that the pines are better if the necessary seedlings are more numerous, moreover, the cover rots where it lies and gives the soil its first supply of organic material. When the forestation is commenced at the very base of the dune the first stands established for a distance of 660 to 980 feet damaged by the ocean winds usually remain stunted and crooked; but under cover of this protective zone the stands which follow it develop normally; it is even stated that the pines on a dune yield more resin than those growing on (ordinary) ground."

COST AND PRICE DATA: According to Huffel the total Dune and Landes pine forest (including State, communal and private) comprised 1,611,121 acres, which represents an investment of $10,331,290 on the following basis:

	Totals in Dollars
74,131.3 acres of dunes reforested by the State at a cost of $10.75 plus per acre $	926,400
1,536,989.3 acres of private and communal interior holdings forested at $4.25 minus per acre	6,602,530
1,611,121 acres of soil at the cost of $0.77 plus per acre	1,258,360
Total $	8,787,290
Road betterments	1,544,000
Grand total	$10,331,290

This is equal to an average investment of only $6.41 per acre. A conservative estimate of yield, before the war, was $2.22 per acre per year. Thus if taxation is eliminated the original investment yields over 30 per cent as a national "speculation," but it must be noted that the real soil value was almost nothing at the time the investment was made. It is at least significant that prior to 1914 timber appraisals of young stands used an interest rate of 7 per cent for the calculations which is unique in forest technique and is due to the high returns and to the risk from fire.

Huffel estimates the average forest revenue in the Landes at $2,702,000 net per year, representing a new capitalization, including timber of at least $86,850,000 or about $54 per acre. As a matter of fact, State forests with growing stock have been sold for around $60 per acre and today average more than $93 per acre for land purchased at less than a dollar! The bare soil sold for $16 to $32 an acre prior to 1914—in other words, it was capitalized on the basis of what it could produce in resin and timber.

The artificial barrier dunes cost about $96 per mile. The forestation cost has been as high as $38.60 per acre in the Landes and in the Coubre dunes only $14.20. In 1817 a large area was sown at a cost of $15.05 per acre. In 1827 Dejean reported the cost per acre had been reduced to $9.26. Today there would be natural regeneration. The cost per acre for hoeing (to 8 inches deep) and clearing fire lines has been, according to Bert, about $6.50, or for a fire line 33 feet wide $26 per mile.

The extremely high price per barrel of turpentine (340 liters or exactly 359 liquid quarts) in 1862 was because of the American Civil war.

According to Conservator de Lapasse, writing from Bordeaux December 16, 1919, the average prices per liter (1.05671 liquid quarts) of resin (resines ou gemmes) for the past 14 years are as follows:

PRICE OF CRUDE RESIN

Year	Price per liter, dollars	Year	Price per liter, dollars
1906	0.050	1913	0.048
1907	0.052	1914a	0.054
		1914b	0.025
1908	0.052	1915	0.046
1909	0.058	1916	0.093
1910	0.071	1917c	0.125
1911	0.079	1918	0.135
1912	0.071	1919	0.208

a Price up to the war.
b Price August 1 to October 1, 1914.
c In 1917 the franc ran 5½ to the dollar, in 1918, about 5½ to 5¾, and in 1919 5¾ to 11½. The normal rate, $0.193 to the franc has been used in conversions.

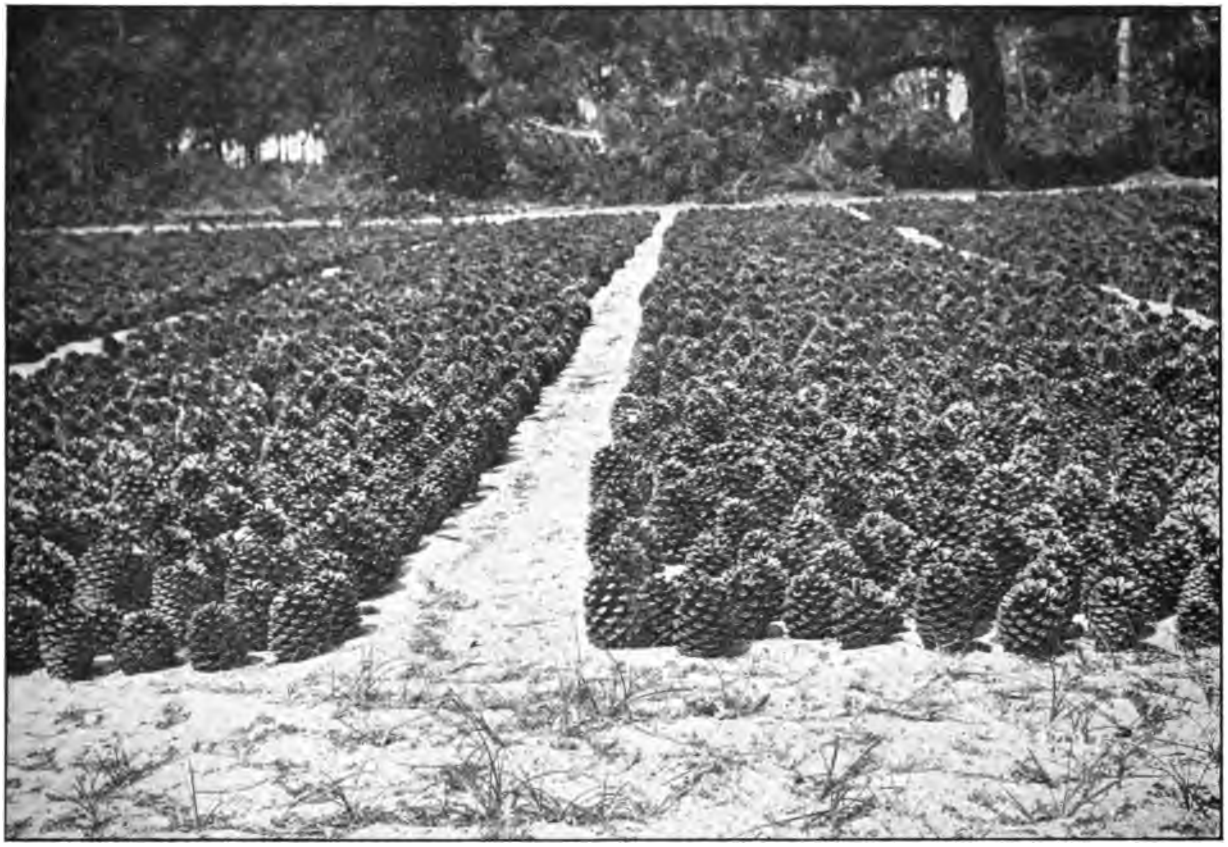
MANAGEMENT OF MARITIME PINE FORESTS

OBJECTS OF MANAGEMENT

(Protection Forests): The objects of State management are to protect the soil from drifting sand and to produce resin, lumber (short length), ties, mine props, paving blocks, and other special wood products. The aim of the Government has apparently been greater volume production, disregarding consideration of the sizes in which it is produced, while private owners look to resin production and to higher stumpage values involved in larger timber. This is natural, because the poorer soils where State timber grows could not produce tall, large saw timber. The State is now looking more to receipts from resin. But according to Barrington Moore:

"The essential difference between Government and private management is that the former aims to produce a maximum volume of wood, whereas the latter aims to produce as much turpentine as possible, and considers the wood as secondary. As might be expected, the Government must care for the needs of the community as well as for revenue. The Government foresters themselves admit that turpentine is more profitable than wood. The silvicultural difference is, briefly, that the Government thins its forests lightly in such a way as to keep a complete canopy in order to grow the trees tall and straight and keep a maximum number per acre, whereas private owners choose the best trees to leave and thin heavily around them to give each tree full sunlight and encourage a large crown development."

Yet, as a matter of fact, the best timber is in private hands, because the private forests usually occupy the richest soils, while the State forests are along the coast. In the Landes and Gironde most of the dune forests are in public hands and they are primarily held as a zone of defense against drifting sand. Of necessity they are heavily thinned relatively to allow the crown development so necessary to a light-demanding species. Moreover, so far as my own investigations show, even State forests outside protection working groups are now managed for resin rather than for lumber. Private forests are in less exposed situations and are managed solely for profit, and resin yields more than two-thirds the income.



Cones of the Pinus Maritima Opened by the Sun Ready for the R emoval of Seeds in the French Work of Reforestation. Photographednear Mauleon.

INTERMEDIATE FELLINGS: After the stand has been regenerated, the sapling thickets are thinned by the so-called "depressage" before they reach merchantable size, to avoid fungous damage, and cleanings are sometimes necessary to protect the pine against the heather.

Under "Improvement Cutting" the Biscarosse working plan provides:

"Cleanings and thinnings without tapping. Commence the cleanings in the regenerated 'periodic blocks' 5 years old; at the same time lop the lower whorls of the vigorous shoots and cut the weeds which suppress the pine. These (cultural) operations should be made periodically every five years and will become thinnings at 10 to 15 years; thus the stand will be systematically thinned and when about 20 to 25 years old there should be about 200 stems per acre. Do not hesitate to cut back the weeds at each period, both broom and furze, with the double object of doing away with thickets which promote conflagrations and to give the pine the air and light so necessary for good growth. It is, in effect, absolutely proven in the Landes that the pineries on cleared soil grow much better than those with thick understory (of weeds). In the older stands the thinnings (without tapping or with the axe) have almost entirely the character of weedings; the advance seedlings of no value at the time of regeneration will then disappear under the cover of the dominant story."

Pruning usually starts at 10 years of age. The typical 3-inch tree is naturally pruned up to 2 feet above the ground, while the typical tree of 6 inches is pruned artificially up to 10 to 12 feet above the ground. The branches, which are left as they fall, take about 5 years to rot. This pruning is done every 5 years. In order to protect stands from fire at the time of cleaning the genista is now cut. Stands artificially sown are usually mixed with a dense stand of genista 10 feet high; consequently the pine has to be freed. The first thinning or cleaning is quite heavy and one stand was noted where there were 800 trees per acre before the thinning that showed only 480 per acre after the thinning.

Regular thinnings "with the axe" without tapping are thus usually necessary before the trees are large enough to stand a face. At about 25 years, depending on the growth, the regular thinnings by tapping to death begin, often preceded by tapping to exhaustion (see quotation below). This merely means that instead of at once felling a tree, which is superfluous or of poor quality, it is first heavily tapped for a period and then tapped to death and cut after four or more years of very intensive tapping. This type of thinning is continued every 5 to 10 years until the stand is mature and rather open.

In the forest of Biscarosse (Landes) thinnings by tapping alive are conducted as follows:

Extract from the revised working plan for Biscarosse (Landes) forest containing an inspection note from de Lapasse of December 21, 1908.

"The thinnings made every 5 years will aim to open up the forest. This favors both the production of wood and resin in maritime pine. The thinnings will aim to maintain the timber in a good state of growth by placing it

under the best conditions for increment; owing to the fact that the maritime pine is a light demanding species one should not forget that in the case of this species the underwood as well as the suppressed trees are valueless and that the upper story alone is of interest. This cultural rule seems much surer than that given in the working-plan report.

"In the regenerated stands the thinnings with tapping will commence at about 25 years of age, or as soon as the timber shall have attained a sufficient size to enable it to stand a face. Except when the removal of a pine is more or less urgent tapping to death or tapping to exhaustion will be followed. The tapping to exhaustion will precede the application of tapping to death by at least the length of a period (5 years); it can then be accomplished by one or by two faces according to the size of the trees. This method of tapping will be applied to the entire stand of each periodic block during the period which preceded regeneration. The tapping without killing (gemmage a vie) will continue to be applied to the pine 14 inches and over at breast height. Very vigorous trees measuring at least 16 inches in diameter can be intensively tapped without killing and receive two faces. This method of extracting the resin can be made general and will be justified chiefly during the three or four periods preceding regeneration.

"The application of exhaustive tapping and of intensive tapping without killing (without injury to the stands) has been rendered possible by the decision of the Director General, dated March 23, 1908, who has authorized the Mont-de-Marsan inspector to reduce the size of the faces in height and diameter."

It should be particularly noted that the so-called exhaustive thinnings which precede the usual thinnings by tapping to death are a new feature of French practice aimed at the increase of resin production in State forests. This means that there is a good deal of marking expense. In 1905, in the inspection of Mont-de-Marsan, 15,180 acres had to be marked; the work lasted practically continuously from February, 1915, to July 8, and the marking removed on an average of almost exactly 40 trees per acre, or 612,455 trees. This illustrates the heavy thinnings followed in State forests—so necessary for maritime pine to develop good crowns. The first cleaning in private forests takes place at 4 years, and the first tapping to death for thinning at 15 years. By 30 years the stand is pretty well reduced to its final number and tapping of all trees alive begins. The "Landes" rule is that no permanent tree should be tapped until it is at least 13 inches in diameter. All private tapping is now being done 4 years to a face.

NEW TAPPING SCHEME: The French have abandoned the fifth year of tapping because of the following objections: (1) Difficulty of chipping the face when it is over 9.8 feet in height; (2) this high face, which is often too deep because of the difficulty of accurate chipping, heals poorly or at least very slowly; (3) an important part of the bole is damaged by a high face. For these reasons the tapping period has been changed from 5 to 4 years. The dimensions for the faces now are:

WIDTH AND HEIGHT OF FACES

	Width		Height	
Yr	Centimeters	In.	Cent.	In
1	9	3.5	60	23.6
2	9	3.5	60	23.6
3	8	3.1	75	29.5
4	7 to 6	2.75 to 2.36	95	37.4
Total			2.90 met.	9.5 ft.

With the former fifth year system in vogue the total height was 3.70 meters (12.1 feet) before 1904; 3.40 meters (11.1 feet) from 1904 to 1909; and 3.20 meters (10.4 feet) since 1910.

According to Cattin and Saint-Jours a period of rest of 1 or 2 years is not always necessary with strong, thrifty trees, although the annual growth is unquestionably increased if the rest is given. On the Florida National Forest in the United States there are 6 years of tapping followed by 3 years of rest; with the French system of tapping such a period of rest is generally considered unnecessary.

In the forest of la Teste trees but 7, 10 and 12 inches in diameter each (being tapped to death) had three faces the first year and later four to five. The trees tapped alive had one face only. Formerly, the faces began on the south side and went to the north, then to the west, and then to the east. Now the first face is placed on the east side of the tree (away from the ocean) where the growth is best, then to the west; the third and fourth faces being regulated by the contour of the tree. The best growth in this locality is always opposite the ocean and the prevailing winds.

This reduction in the length of the tapping period, when applied to forests being worked on 5-year cycles, will mean the revision of working plans. The regeneration by clear cutting will be every 4 years instead of 5 years as formerly, and the cycle for thinnings will also be reduced from 5 to 4 years. In the future the cleaning will be made earlier after regeneration, since experience has shown the inconvenience of waiting for 5, 6, or 7 years as was formerly done.

TAPPING OTHER SPECIES: According to unpublished notes loaned the writer by Cuif in 1912, he has concluded finally that the tapping of Austrian or Scotch pine will never be commercially practicable without a decided increase in present turpentine and rosin prices. This agrees with the results in other forests which are not usually tapped for resin. For example, in Corsica, during the extremely high prices caused by the American Civil war, Corsican pine had been tapped for awhile and then abandoned; the same was true of California yellow pine.

RESIN SALES: According to a digest of resin tree-sales made at Mont-de-Marsan, October 5, 1915, for the period 1910 to 1914, inclusive, the policy of favoring the small operator is just as much in evidence as with ordinary timber sales in other parts of France. The payments which are made annually vary between $400 and $2.000 and, ordinarily are less than $1, 500. If a large company, for example, desired to secure a considerable area for resin operations, it would be necessary for it to bid in a number of contiguous or nearly contiguous resin sales, some of which might be advantageously located for a small local operator. This clearly results in a better price and gives the small operator an excellent chance to secure areas convenient to his home. Each bidder is supplied with detailed data as to the stand and estimated products, boundaries, methods of removal, and charges, as in the case of ordinary timber sales.

Each operator is informed that payment must be made annually for a period of five years, that in the thinnings the pines to be tapped to death are marked with two imprints of the State marking hatchets, one on the bole and one on the roots, while trees to be tapped permanently with one face are stamped once on the bole; if two faces, two stamps on the bole, one below the other. Contractors who do not furnish the fire fighting tools must understand that they will be bought by the Waters and Forests Service and charged to their account. Foreign workmen can be hired only up to 10 per cent of the total number employed. A fixed price for the transport of products from Federal forests is agreed upon with the local railways and the rates furnished the contractor. In some instances the Forest Service has built narrow and broad gauge railways on State forests which are leased to the operator or to connecting lines.

In 1836 (according to J. H. Ricard) H. Serres suggested terra cotta troughs instead of the wasteful "box" cut in the base of the tree. Hughes, in 1841, suggested a small earthenware pot but the improved methods were not adopted until about 1855 or later. Galvanized sheet-iron "cups" have been tried because they are light-

Yard Scene at a French Distillery. The Barrels of Rosin Weigh from 700 to 800 Pounds.

er than the earthenware pots. The nail to hold the cup is a bad feature, since it might be left in the butt log and cause damage to saws at the mill. Probably the ideal "cup" has not yet been invented. It must be easy to place, secure, easy to remove, and must not damage the tree. Ricard states that the yield of resin is greatest near the ocean, with thrifty, rapidly growing trees, with thin chipping at frequent intervals, and with hot weather.

FRENCH AND AMERICAN METHODS CONTRASTED: The main difference between tapping methods in France and America seems to be in the width of the face and the annual rate of increase in its height, and the number of faces per tree. In the United States the first streak cannot begin higher than 10 inches above the ground. In France it can be anywhere above the root swelling. In the United States the maximum depth of streak is 0.5 inch; in France it is approximately 0.4 inch. In the United States in Federal tapping operations no tree less than 10 inches can be tapped, and trees 16 inches and over can have two faces, while trees 10 to 16 inches can have but one face. In France the minimum diameter of trees tapped alive on State forests (trees to be removed in thinnings can be tapped to death no matter how small) is 13 inches and the number of faces is specially designated by the local forest officer. In the United States the face can be 12 to 14 inches wide, with no specified decrease in width as the face proceeds up the tree. In France it is 3.5 to 2.4 inches, decreasing each year as the distance above the ground increases. The maximum height increase per year in the United States is 16 inches, while in France the face can be lengthened 24 to 26 inches, and even up to 39 inches in case of 4-year tappings. Without exhaustive experiments the best methods to follow cannot be stated, but tentative results from the Florida Forest in the United States show the French system is not applicable to mature, large timber and that the yield in resin per square inch of face is slightly greater with the American (Government) wide faces.

TECHNIQUE OF TAPPING: The trees of State forests for tapping alive are blazed on the bark and stamped "AF" at the base and at breast height.

It is necessary for a good worker to be able to cut a thin, even slice of wood to increase face and to continue the face vertically following the grain of the wood. The sliver is about 3 inches wide, 5 to 7 inches long, and usually less than 0.4 inch deep. The first step is always to smooth the outer bark with the axe. The tendency is to bark too large rather than too small an area. In placing the gutters care should be taken not to cut into the tree with the place-crampon more than 0.2 inch; this is a sufficient depth, inasmuch as the gutter is glued by the sap as soon as it flows, and besides if the gutters are set too deep it is very difficult to remove them in the autumn. The gutter should, of course, be slightly inclined toward the ground so that the sap will run off into the cup. There seems to be a good deal of variation in the frequency of tapping. Some chip once a week during the entire season, others every 5 days, while still others will only chip once every 12 or 15 days; this latter method decreases the resin flow. On the whole, it is better to chip at regular intervals

Departure for the Pasturage of a Landes Flock of Goats.

with the rule that the chipping would be more frequent during the hot weather in the summer than during the spring or autumn. A common rule followed in the Landes is to "chip once every 5 days from May 15 to September 15, and once a week during the remainder of the period."

The cups are usually cleaned seven times a year and the rain is poured out after the chipping. The trees are scraped once some time between October and December. It is usually recommended to begin the first of March and continue until the end of October.

J. H. Ricard, writing in 1910, made the following conclusions: "Tapping operations are from March to October. The face should be chipped every 8 days in spring and fall and every 4 to 5 days in summer. The pot should be emptied every 2 to 3 weeks and there should be one barrel for storage per 1,000 trees tapped. There are about 40 chippings per season and the cut should be less rather than more than 0.3 inch. Wide faces are unnecessary because the resin comes from the sides of the cut and "the return in resin has not been proportional to the surface of the face." After 4 years of tapping trees should be given a rest of 2 to 3 years. Trees under 8 inches in diameter are rarely tapped unless they are to be removed in the thinnings. A workman can chip 1,000 to 2,000 pines, according to the ground, and covers often about 4,000 trees during the season."

It is not only necessary to secure a quantity of gum, but also to secure a good quality. Therefore, it should not be allowed to deteriorate in the cups. On the other hand, to collect too freequently means unnecessary expense. To dip ten times per season is hardly necessary, while seven or eight times is a good average. Five collections a year is not often enough. The difference between good, clean resin and that which is full of chips and other debris may amount to as much as 96 cents per barrel.

The workmen received, before the war, one-half the resin for their pay and the operator or owner furnished the cups and gutters. The smoothing off of the bark begins the last of February and the scraping off of dried pitch is usually finished in early December. In the interim the resin tapper's work at clearing underbrush and pruning young stands.

EFFECT OF TAPPING: There is no question but that the turpentine operation decreased the rate of growth of maritime pine, but, on the other hand, it makes the wood harder and more durable and the impregnation even extends to the heartwood. The general opinion is that tapped trees are better for flooring, boards, ties, and planks, while untapped pine is better for telegraph poles, mine props, and box boards. Unquestionably the quality of the wood diminishes after 25 to 30 years of tapping alive, and is inferior to wood cut from trees tapped to death for only 3 to 4 years.

YIELD OF MARITIME PINE: In 1892 there were 105,763 acres of conifer State high forests in the Landes, and in addition, 22,625 acres or between one-fourth or one-fifth as much as the productive area, had to be given up to protection. The production amounted to 30,072 cubic meters of timber (about 8,360,000 feet board measure or 80 feet per acre) and 4,161,960 pounds of resin (gum).

The yield of maritime pine stands in the Mont-de-Marsan Inspection for the year 1905 showed a total of 47.6 cubic meters per acre (on an area of 22.2 acres) for pine 40 to 50 years old. According to Lapasse:

"The resinous products represent approximately one-fifteenth the total weight or 7 per cent. of the yield in weight of a maritime pine felling; the proportion of the product realized then, in weight, is wood product fourteen-fifteenths or 93 per cent, resinous products one-fifteenth or 7 per cent. The production of resin (gum) is variable; it depends on the density of the stand, on the underwood, on the state of growth, the size of the trees, the age of the face, the distance from the ocean, and on the skill of the workman. The yield attains its maximum in open stands completely cleared of undergrowth, situated near the sea and during the second or third year of tapping. A humid and hot atmosphere favors the secretion of gum. The yield in resin is, on an average for 1,000 trees tapped alive, 640 quarts. . . per year, and in 5 years, the duration of the tapping alive, 10,200 quarts. One might say that . . . . . 166 pines can yield annually a barrel of resin, but in order to collect 100 quarts it is necessary to have 50 pines tapped alive, each tree producing an average of two quarts. In the thinnings 1,000 trees tapped to death may yield (according to the size of the trees) from

A Postman on His Rounds in the Landes.

four to six barrels of 340 quarts each, or an average of five barrels, or 1,700 quarts, per year, and in the 4 years duration of the tapping to death, 6,800 quarts. In this case, 200 pines . . . . produce annually a barrel, or 59 pines tapped to death are necessary to obtain 100 quarts of resin. In the regeneration fellings with pine 65 to 70 years old with four faces each, each face can produce 1½ quarts or 6 quarts per tree per year. One thousand pines tapped to death should produce 6,000 quarts or about 18 barrels per year, and 24,000 quarts in 4 years. An acre stocked on an average with 80 trees will yield about 480 quarts of resin per year and 1,920 in 4 years. To collect 100 quarts of resin it is necessary to have seventeen pines tapped to death per year."

These figures are below rather than above the average. In the thinnings marked during 1900 to 1905 on a total area of 57,847 acres in the Inspection of Mont-de-Marsan, with the trees averaging 40 years in age, the average yields per acre were as follows: (1) Timber products, 22 pines removed, with a volume excluding branches of 3.6 cubic meters, about 1½ cords (or roughly 750 board feet). (2) Resin products, total yield for the 5 years of tapping, including the pine tapped alive, 340 quarts.

The average return per acre from the timber was $3.42 (average price 95 cents per cubic meter on the stump). During this period the value of resin varied from $10.61 to $17.37 a barrel (of 340 quarts). Excluding 50 per cent of the value of the resin as the labor cost, the net value of resin rights was $1.98 per 100 quarts, and the total average yield from thinnings was $10.15 per acre ($2.03 per year). Thus the yield from resin is twice that of timber.

During the same period the clear-cut regeneration fellings yielded an average of 131 trees per acre (80 to 84 trees per acre is a fairer average), and the yield per acre was 48 cubic meters—6,500 quarts of resin (about 10.9 thousand feet board measure) at a total net price of $116.76 per acre for land, which, had it not been forested, would not only have been worthless today, but would even have constituted a menace.

B. ALGERIAN FORESTS AND FORESTRY

EXTENT OF FORESTS: The wooded area in Algeria, as has been stated, is about 6,918,800 acres, of which some 4,324,250 acres are federal and 172,970 acres communal. The area under military control is about 864,850 to 988,400 acres.

Aleppo pine, 1,482,600 to 1,729,700 acres; maritime pine, etc., 37,065 to 49,420 acres.

PRODUCTION: Though the revenue from Algerian forests is derived from a number of species, cork oak yields the major part of this total; and even then the present production is only about half of what it should be. Cedar is sold to some extent, but it is just within the past few years that the wood has been in demand. The aleppo pine had not yielded a revenue until the recent experimental tapping, originated by Conservator Laporte at Oran, and described hereafter.

ALEPPO PINE: Next to the cork oak the aleppo pine has the greatest commercial possibilities of any species in Algeria. If it can, as seems probable, be properly developed to yield resin, this potential value will become a fact.

Conservator Laporte at Oran has started progressive experiments on a practical basis, to determine whether or not tapping is feasible. Work has begun in the "chefferie" of Telegh, which comprises some 267,886 acres at an average elevation of 3280 feet, and where in winter snow occasionally reaches a depth of 1 to 2 feet. The aleppo pine is found here in almost pure stands, with an infrequent mixture of holm oak and thuga.

A trial tapping was commenced in 1906 on a commercial scale and is now extensive enough to justify the maintenance of a still. The price fixed by the 1907 concession was $0.009 per tree per year. payable in two equal installments on July 15 and January 15.

The contract governing the method of tapping the tree allows a maximum width of 3.5 inches for the scar during the first 2 years, 3.1 inches the third, and 2.7 inches the fourth; a height of 22 inches the first, 24 inches the second, and 26 inches the third and fourth marking. A total maximum height for the scar of 8 feet is allowed after 4 years; the depth may reach 0.4 inch. All trees must be at least 36 inches in circumference before being tapped. Experiments prior to the initiation of the present working

The Shepherd of the Landes. His Furs Were Made by Him from Sheepskins.

group had already shown that aleppo pine only 31 inches in circumference could not be safely tapped, and that 6 years of continuous tapping was too long.

This development of a turpentine industry in an arid country with no means of forest communication has raised certain serious problems, namely, the commercial success is more or less dependent upon good prices for turpentine; the initial expense for road development was considerable, and if the enterprise were to fail the building of the road could hardly be justified on any other grounds; no adequate provision can be made for reproduction; even if regeneration does come in naturally, there will be vast areas of young growth which will yield nothing, and which will constitute a great fire menace; the necessary periods of rest are incompatible with the maintenance of the industry.

These problems may be solved by fixing a rotation suitable for tapping and for the production of wood; exploitation must be arranged systematically and the young stands must be thinned.

Thus, if 35 inch trees were tapped in 1910, 1911, 1912 and 1913 they would be felled in 1914; the same cycle would be carried out in 1914 to 1918, and 1919 to 1922, etc. The effect is that the felling and the first year of the new tapping would progress simultaneously. The regeneration fellings are not made by clear cutting, as in Landes, near Bordeaux, only trees 23 inches and over in circumference being felled, but this diameter limit system is varied according to the amount of existing reproduction on the ground.

As in Landes, "tapping to death" for thinnings and tapping alive on trees destined to form the final crop is practiced. The yield from 1387 scars (on trees tapped alive with one scar) averaged 2.07 quarts per year. For trees tapped to death the average of 1326 scars was 2 quarts.

TREATMENT: It might be supposed, after the disasters from fire in even-aged coniferous stands in Corsica the selective system would be applied to the aleppo pine in Algeria, but according to a recent working plan:

"Each of the three working groups will be treated by the shelter-wood method. The selection (system) which increases the confusion of ages and renders difficult the removal of the fellings, cannot be considered.

"The surface of each working group will be divided into 'coupons' (small felling areas). The regeneration felling will be laid in succession in each of these felling areas. It will be made by tapping to death during a period which will be determined later.

"In this regeneration felling the trees more than 23 inches in circumference must be felled, but those 23 inches and below should be kept with existing regeneration. In the felling areas, where the regeneration on the ground is considered sufficient, all old trees will be marked for removal. On the other hand, the marking must be conservative in the areas where the stand consists of mature timber only, without young growth already on the ground. Future regeneration presents in reality several uncertainties in stands of this kind."

The working plans offer further states that in very open stands only the dead and dying should be removed; in dense stands thinning is accomplished by removing up to half the material; the trees reserved should be left near openings; the marking should be light within 22 to 33 yards of fields and clearings; a zone of 218 yards in width should be reserved from cutting along the southern boundary of the forest. The concluding instructions are:

"At the same time these regeneration fellings are marked the other felling areas will be cut over by improvement fellings of two kinds.

"1. In the young stands, these fellings will be simple thinnings, with the aim of opening up the stand and assuring as rapid a growth as possible.

"2. In the older stands, where the boles may be tapped, it will aim to choose the trees which will form the final stand, and the trees to be cut will be tapped to death.

"3. Finally, on the entire area of the working group not cut over by regeneration fellings, tapping alive will be followed on all trees 3 feet or more in circumference as explained later."

A curious feature of the aleppo pine seems to be that it exhausts the freshness of the soil more than would be expected, and lowers the surface water quite materially. It is a matter of record that after clear cuttings at Rivoli the water level rose and where

extensive plantations were made the water level sank.

The working plan for the aleppo-pine forest of Takrouina follows the same general outline used in working plans for cork oak. Inthis forest the yield is also regulated by area with the rotation of fellings, as follows: (a) Regeneration; (b) Thinnings in young sapling stands, 20 years old, which will probably cost some outlay; (c) When the trees are large enough the thinnings will be made by tapping to death the trees which are marked for thinnings; (d) Tapping alive during the life of the tree after it attains a proper size.

The author of the working plan states:

"An average tree of 1 metre (39 inches) in circumference is thus 72 years old; one can therefore assume that the average growth is 1.00/72= 0.139 (0.547 inch) and that a tree of 80 years would be 80 times 0.0139 or 1.11 m. (43 inches).

"We have then to fix the exploitable age at 80 and the size for the trees to be tapped at 1 metre (39 inches) of circumference. We propose besides to fix the period for tapping at 4 years, with an additional year for felling."

The working plan recited the sequence of the four classes of fellings in the forms which follow:

SEQUENCE OF REGENERATION FELLINGS: Small felling area occupied by the timber of each age class; total area of the felling; age of the timber in 1912; felling classed as (a) abnormal and (b) normal, with under each the age and period when the trees are to be cut by tapping to death; remarks.

Sequence of thinning (by day labor); periods; felling area to be divided (a) into the portion from each felling area and (b) total per year; age of wood at the time for thinning; remarks.

Sequence of thinning by tapping to death; same as preceding.

Sequence of exploitation by tapping alive; periods; small felling areas; notes on work to be done.

C. CORSICAN PINE — MANAGEMENT IN CORSICA

By far the most important timber tree is the Corsican pine, which has usually grown in pure, even aged stands, though in mixture with maritime pine at its lower range and with beech and occasionally fir at its upper limit. Notably in the forest of Vizzavona the beech seems to be driving the pine out of the higher valleys.

The largest forests of Corsican pine are Aitone, Valdoniello, Asco, Tavignano, Marmano, Melaja, Verde, and Vizzavona. The pine reaches 148 to 164 feet in height, and is sometimes 6.5 feet in diameter; but it is very slow in growth, especially after 200 years, and takes 350 years or more to grow to a breast-high diameter of 2.9 to 3.3 feet. Trees have been found 900 to 1000 years of age and still sound. In old age the crown is mushroom shaped.

A number of stump counts were made to gather rough data on the rotation. The figures which follow were collected by the writer in recent cutting areas:

Diameter, breast high — Metres	Diameter, breast high — Inches	Total age, years (10 years allowed for stump height)	Remarks
0.28	11	90	Still growing rapidly.
0.46	18	92	Still growing rapidly.
0.48	19	115	Still growing rapidly.
0.66	26	160	Still growing well; suppressed for first 30 years, but showed remarkable recovery.
0.74	29	270	At 145 years growth slowed up.
0.74	29	260	
0.97	38	550	At 160 to 200 years growth slowed up.
0.99	39	480	At 175 years growth slowed up.
1.02	40	500	At 200 years growth slowed up.

These figures are too scanty to allow of deducing reliable conclusions, but it is significant that the trees are growing rapidly up to 160 to 200 years, while after that age the rings often cannot be counted without a magnifying glass.

The wood of the Corsican pine is used for lumber and dimension stuff. During the years 1856 and 1872 trees were tapped for resin because of the high prices prevailing during the American Civil war. They produced a good quality of resin but gave a scanty flow, and the results today show that this tapping killed a good many of the mature trees and slowed up their growth. The average mature and over-mature stand of Corsican pine closely resembles the western yellow pine stands in Arizona and New Mexico, except that the tree does not grow in such typical groups.

Maritime Pine: The maritime pine is found pure or in mixture with holm oak and Corsican pine. It is of rapid growth and attains a large size. In the forest of Marmano a 39 inch tree was found 66.6 feet high and containing 3½ good 16-foot saw logs. In the same forest trees 28 and 29 inches in diameter and 115 and 125 years old, respectively, were both rotten at the heart.

The species was tapped in 1862 and 1872, and operations were recommenced on a large scale in the forest of Zonza in 1908. A local distillery has since been erected at Zonza.

The most important forests of maritime pine are Zonza, Calenza, Pastricciola, Vero, Pineta, Solenzara, Marghese, Vallemala. In these forests the privilege of tapping for resin is granted as follows in connection with the sale of timber:

"Unless otherwise indicated in the bill of sale and in the minutes of sale, the pine marked for felling can be tapped for resin without any special charge."

For this sale the resin yield per tree and per year is estimated at 1.3 quarts for maritime pine and about 1 quart for Corsican pine.

As in France, two methods of tapping are recognized in this sale: (a) tapping to death when an area is formally opened for felling and (b) tapping alive in compartments where cutting is not in progress. In (a) there are no restrictions as to methods, but in (b) the following are the essential rules to be followed: only one face is allowed at a time; this face must be begun above the root collar and continued vertically; its maximum length may be for the first year 24 inches, "and each of the following years 27 inches, provided the total height of the face does not exceed 4 yards" at the end of the 5-year tapping period. The maximum widths are 4.54 inches the first year, 3.14 inches the second, third or fourth, and 2.75 inches the fifth. The incision below the cambium must not exceed 0.39 inch. New faces must, if possible, be on the opposite side of the tree. Where the full tapping term cannot be enjoyed, the conservator has the privilege of modifying the maximum heights and widths. The season for regular tapping is March 1 to October 31.

TURPENTINE OPERATIONS: The rights to tap alive 53,849 maritime pine trees in the forest of Zonza sold for $2962.55 in 1908 for the 5-year period 1909 to 1913. Unfortunately, because of labor troubles, only 18,000 trees, or one-third of the stand, were tapped in 1909, but in 1913 the lease

was in full swing and was being profitably operated. The company has installed a local still at Zonza, to save the 30-mile wagon haul and ocean shipping expense on the raw product.

One of the most promising features of the lease is the apparent immunity from fires which this area enjoyed. It is known that many of the local citizens are personally interested in the operating company and consequently the villagers make every effort to keep out fire. The small area of maritime pine which increases the difficulty of tapping and collecting the resin, are two important drawbacks.

The yield has been satisfactory, but less than in the Landes. In 1910, 19,000 pines (each with one face) yielded 43,958 quarts of resin or 2.3 quarts per tree, Landes average 2.1 quarts per tree, while 6,000 trees yielded 0.34 of a quart per tree, giving an average of 1.8 quarts per tree. In 1911 the average was 1.9 quarts per tree. Taking a price of 115 francs ($22.19) per barrel of 340 liters (359 quarts) (average price in the Landes for 1910), the gross yield of this Zonza sale should be 5760 francs ($1111.68).

The same methods that have been applied in the Landes for maritime pine are followed in Corsica, except that the width and length of the faces have been varied to a small extent.

There seems to be little chance for profitably tapping the Corsican pine. The ground is hilly and under the selection system only scattered trees are marked for felling. These alone could be tapped to death, and because of its slow growth and inability to heal wounds quickly the advisability of tapping alive is seriously questioned.

Minor Industries: The extraction of pine stumps for turpentine is encouraged and a very low price has been established: 39 cents per 35 cubic feet, or about $1.40 per cord.

NAVAL STORES INDUSTRY IN THE SOUTHWEST OF FRANCE

(By U. S. Consul T. Jaeckel, Bordeaux.)

THE district within the jurisdiction of the Bordeaux consulate includes an area which, from the point of view of the production of naval stores, ranks second in importance to the long-leaf pine area of the southern part of the United States. It is estimated that approximately 2,665,030 acres of land in this region are covered with turpentine and resin producing pine trees. Of this total area, known as the "Forest of Gascogne," 1,276,538 acres are situated in the Department of the Landes, 1,141,392 acres in the Department of the Gironde, and 247,100 acres in the Department of Lot-et-Garonne.

The production of naval stores in this territory for the year 1913, which may be considered as a typical pre-war year, amounted to 110,000 metric tons (metric ton equals 2,204 pounds), consisting of 25,000 tons of turpentine and 85,000 tons of resin. Approximately 30 per cent of this output, valued at 30 million francs, was exported to England and Germany, in the proportion of 70 per cent to the former and 30 per cent to the latter.

The quantities of naval stores produced in this district since 1913 are given as follows, in metric tons:

Year.	Turps.	Resin.	Total.
1914	19,000	64,000	83,000
1915	12,000	43,000	55,000
1916	17,000	60,000	77,000
1917	17,000	60,000	77,000
1918	20,000	68,000	88,000
1919	25,000	85,000	110,000
1920 (est.)	35,000	120,000	155,000

(Reduced to American packages the 1920 crop is approximately 217,000 barrels of spirits turpentine and 528,000 barrels of rosin.)

The diminution in production for the years 1914 to 1918, inclusive, was due to the mobilization of the workers in the pine forests; but it will be seen from the above table that 1919 was marked by a return to the normal output of pre-war years.

For the present season, which ends between November 15 and November 30, the amount of naval stores produced in this region will, it is estimated, reach the unusual and very satisfactory total of 155,000 tons, or 35,000 tons of turpentine and 120,000 tons of resin. This output, which will represent an increase of about 55 per cent over the pre-war production, is being attained by intensive working of the pine forests brought about by the high prices prevailing for naval stores. Of this estimated production for the current season, reliable authorities believe that approximately 97,000 tons will be exported, or 17,000 tons of turpentine and 80,000 tons of resin. The export value of this unprecedented quantity of naval stores, according to the same sources of information, will reach the sum of 180,000,000 francs, which is double the value of the naval stores exported from France in 1919.

The naval stores' industry, which, together with the pit-prop interests, forms the most important source of the wealth of the Landes, was recently aroused to a point of unusual anxiety over a decree which was published by the French Government in the Journal Officiel of October 23, 1920. This decree prohibited the exportation of turpentine and pit-props except by special license. It also provided that in cases in which an export permit was granted for these products, an export tax of 20 per cent was to be levied.

On October 28 it was unofficially announced that the Government had postponed the enforcement of the terms of the decree until January 21, 1921, as regards pit props, and until March 1, 1921, as regards turpentine. The free exportation of turpentine will therefore probably be assured until the end of February, 1921.

It is interesting to note that an important naval stores producer of the Landes recently bequeathed the sum of 20,000 francs to the scientific faculty of the University of Bordeaux, the laboratories of which have in the past rendered helpful service to this industry of the southwest of France, for the purpose of creating an institute for the study of the pine (Institut du Pin).

THE NAVAL STORES INDUSTRY IN SPAIN

(By H. Gaertner, Naval Stores Dealer and Exporter, San Sebastian, Spain.)

THE new crop of naval stores begins in Spain very late, not before May-June, because the pine forests are situated in the highland, near the mountains, "Guadarrama," where the climate is very raw and the golden fluid does not run down so early as in France, where the pine forests are in a country very flat.

The Spanish resin called "Miera" is very pure and gives by distillation a quality of rosin at least six qualities whiter than in America.

The distillation is operated in the same manner as in France, some distillers by steam and others by direct fire.

The forests are hired by the government or proprietors for five, ten or more years. Before the war, the price of a tree was about 5 centimos for a year, but in 1920 the distillers offered 2 pesetas and more for a tree, and this price for a period of ten years, in the hope that the high prices of naval stores produced would continue for a long time.

(The peseta is equal to 19.3 U. S. cents.)

The market is regulated by the company "La Union Resinera Espanola," which has about twenty factories and produces more than half of the entire Spanish production. The shares of this company have risen in a period of three years from 50 points to 1,300 points, and in the same proportion the distillers have gained very much in the last three years.

As all other factories sell on about the same basis as the company U. R. E. and there is no foreign currency here, the prices are always very high.

The production of naval stores products in Spain is continuously important. In rosin the production is twenty to twenty-five millions kilograms. In turpentine the production is six to seven millions kilograms.

The exportation for recent years was as follows:

Rosins.

1916	10,733,289 Kg.
1917	10,435,572 Kg.
1918	5,346,476 Kg.

Turpentine.

1916	3,735,019 Kg.
1917	4,115,357 Kg.
1918	2,319,388 Kg.

Reduced to American figures this correspondent's statement gives the following results as to the Spanish crop:

Production—Rosin.

20 million kilos net, American barrels of 500 lbs. gross	106,024
25 million kilos net, American barrels of 500 lbs. gross	132,530

Production—Turpentine.

6 million kilos, barrels of 50 gals.	37,714
7 million kilos, barrels of 50 gals.	44,000

Exports—Rosins.

(In barrels of 500 lbs.)

1916	56,900
1917	55,321
1918	28,343

Exports—Turpentine.

(In barrels of 50 gallons.)

1916	23,477
1917	25,868
1918	14,579

PRODUCTION OF RESINOUS PRODUCTS IN SPAIN

(From the Ministerio de Fomento, Madrid.)

ACCORDING to certain authorities, in the year 1898 the production of resinous products in Spain was approximately nine million kilos while ten years after, namely, in the year 1908, this production had increased to twenty million kilos. After that date the variations have been only slight, as appears from the accompanying statement.

The contribution of La Union Resinera Espanola, domiciled in Bilbao, to the output, may be estimated at 70%. This figure is mentioned in order to make it possible to determine the total output of the nation.

The average composition of the Spanish product is as follows:

Average Percentage.

	Pinus-laricio	Pinaster
Turpentine	18.32	20.57
Colophony (resin)	73.39	71.67
Foreign matter	8.29	7.76

The domestic consumption of turpentine in the year 1912 may be estimated at one-sixth of the production and of colophony (resin) at one-half of the production.

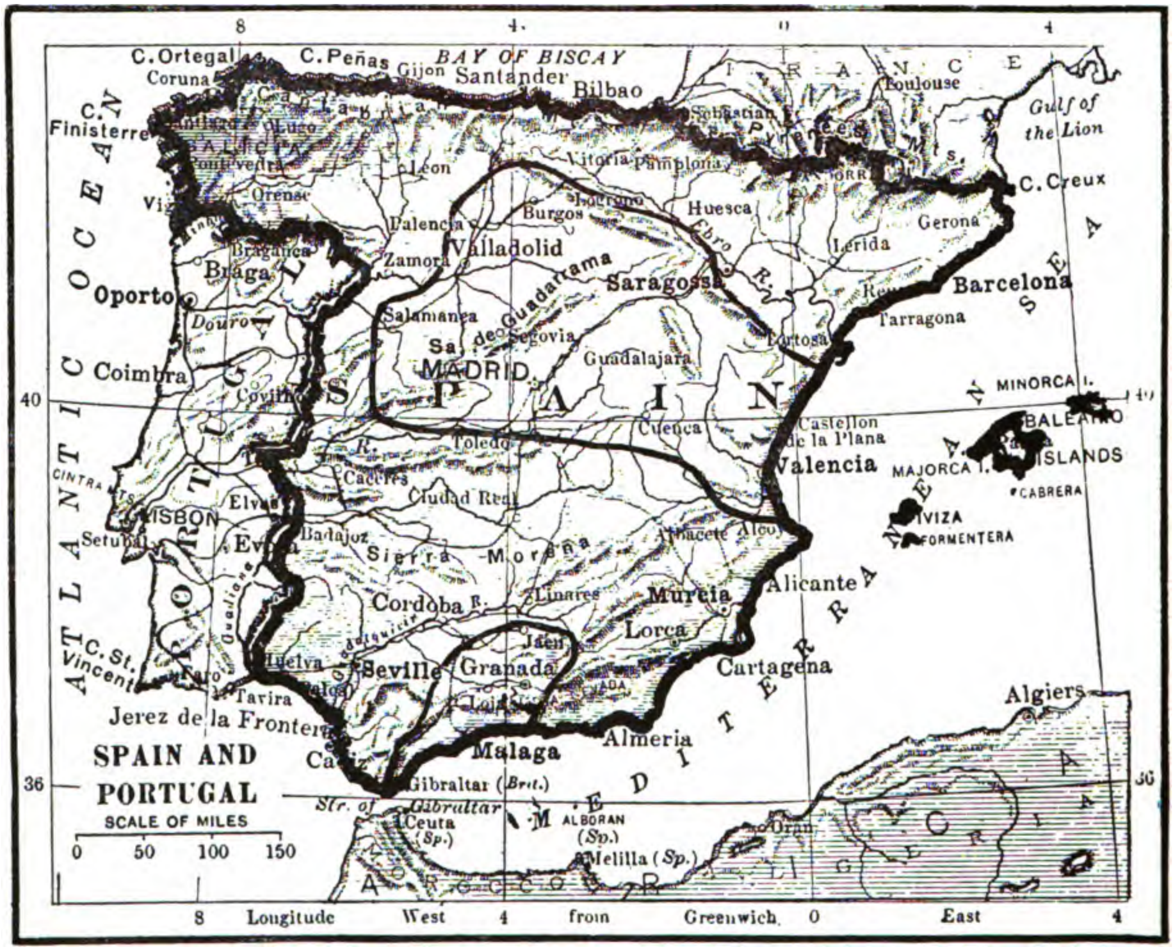
SPAIN'S PRODUCTION, EXPORT AND IMPORT OF RESINOUS PRODUCTS.

(Quantities are in Kilogrammes.)

	Export.		Import.	Production Union Resinera S. A.	
Years.	Resin.	Turps.	Colophony.	Turps.	Colophony.
1908	7,670,489	3,694,187	1,318,673	4,684,712	15,766,465
1909	6,754,680	3,757,395	1,459,845	4,652,594	15,369,639
1910	10,237,048	3,819,444	1,150,132	4,727,873	15,235,741
1911	8,849,148	3,676,849	888,840	4,477,355	16,214,797
1912	11,370,946	3,282,666	335,034	4,971,161	16,820,258
1913	8,313,670	4,341,362	309,660	4,892,395	16,842,460
1914	8,685,296	3,436,509	292,792	4,977,652	16,077,709
1915	13,320,201	3,010,064	191,586	4,331,429	15,054,593
1916	10,351,773	3,735,702	170,045	4,868,871	16,239,545
1917	10,435,572	4,115,357	89,626	4,599,066	14,364,773

HISTORY OF THE NAVAL STORES INDUSTRY IN SPAIN

(By Ciro Del Moral.)



The best pine forests of Spain are found within the center of that country, not very far from Madrid, and principally in the Provinces of Segovia, Avila, Valladolid, Guadalajara and Soria, but there are also some good pine forests in the Provinces of Burgos, Leon, Tereul, Cuenca, Salamanca, and some in Valencia and Castellon, all of which territory is within the black lines. In the south there are pine forests in Granada and Malaga.

THE following was prepared by Mr. Ciro del Moral, prominent in French and Spanish naval stores circles, for the Naval Stores Review in 1912:

The growth of the rosin industry in Spain is very curious, and is certainly worth writing an article about, because its exploitation is different from that in any other country because this country, by uniting the distillers, has given a unity to the industry which is not found in either France or the United States.

Until the year 1862, very few trees in Spain were worked and even these were worked by the system "to death." In 1848 a distillery was established in Ontoria del Pinar (Province of Burgos), and later on others were set up in the provinces of Valladolid and Albacete, all of which did not give satisfactory results, and the proprietors were obliged to close them up.

In 1862 there came to the Province of Segovia two Frenchmen, residents of Mont-de-Marsan (Landes), called Ernesto and Leopold Falcon, who, together with two Spanish men, Llorente and Ruiz, installed in Coca (Segovia) a distillery which exists to this day, and

which is without doubt, in regard to production, the most important in Spain, and one of the foremost in Europe. The Falcon brothers, who had learned the industry in their own country, introduced into Spain the Hugues system of securing the gum, that is, by working the living tree, which system is today used throughout Spain. The American war of secession was very favorable to the growth of this enterprise, and in 1878 steam was employed in Spain for the first time in the distilling of the gum.

In 1878 other factories were established in Valladolid. In 1871, a lady of the highest Spanish nobility, the Duchess de Denia, widow of the Duke de Medinaceli, set a high example of public spirit and love of country by having a distillery installed in her magnificent possession, called Las Naval del Marques (Avila). This gentlewoman, whose example others should imitate, was during her whole life an enthusiast regarding anything referring to rosins. She herself took charge of the direction of the work, and while she lived, never wished to sell either the distillery or the property, but, as becomes true nobility, in place of competing with other distilleries turned her production over to the "Union Resinera Espanola," when this was established, in order to place it on the market.

Later, in 1882, the Forestry Engineer, Don Calixto Rodriguez, constructed another distillery in Mazarete (Guadalajara) after which others soon followed in the Provinces of Asturias, Leon and others.

The Treaty of Commerce between Spain and France, made in 1879, almost ruined the Spanish rosin industry, because the French product paid an import duty of about .41 peseta (about 8 cents American) per 100 kilos (220 lbs. avoirdupois), and as "les Landes" (French) were situated right at the Spanish border, and also on the sea, with excellent facilities for shipment from the latter to the great centers of consumption in Spain, such as Bilbao, Sevilla, Sontander, etc., it resulted that the Spanish, whose distilleries were mostly situated near the center of the country and who could not secure advantageous railroad rates, could not compete with the French products. Many stills closed while the rest carried on a precarious life, without any profits. Also the distilleries, between which there was severe competition, were gradually ruining themselves.

Seeing that this situation could not continue, many of the distilleries formed a syndicate, only for the sale of turpentine. With this, not only did competition cease, but the efforts of the syndicate resulted in the Spanish railroads granting more advantageous rates for these shipments, and in 1892, on renewing the Treaty with France, a custom house duty of ten pesetas (about $2.00 American) per 100 kilos, (220 lbs. avoirdupois) was placed on French turpentine, and four and one-half pesetas (about 90c) on the dry products. Spain, which had been importing rosin products, now began to export them.

The Syndicate for the sale of turpentine progressed nicely and those in charge decided to further its growth in order that the manufacture of rosin products in Spain should be all in one pair of hands. To this effect, assisted by different capitalists in Bilbao, there was established in 1898 a stock company called "La Union Resinera Espanola," which is still in operation, and almost monopolizes, you might say, the Spanish rosin industry. The distillers forming the syndicate for selling, turned over to the new company all their stills, their rights on pine lands, etc., and in exchange received the corresponding number of shares in the new enterprise. "La Union Resinera Espanola" was founded originally with a capital of five and a half million pesetas (about $1,100,000), but later this was increased to twenty million (about $4,000,000), to enable them to secure certain stills and install others. At the death of the Duchess de Denia, in order to buy her properties, for which they would have to pay six million pesetas, and also to secure some other pine lands, the company issued twelve million pesetas worth of shares.

Besides this company, there are a few minor distillers in Spain, of small importance, and the company buys most of their production. The only exporter is the "Union Resinera Espanola." Of the small distillers those who do not sell their production to the company, sell the same in the national (Spanish) markets, which is to their better advantage.

Contrary to what has occurred in France and the United States, where the pine forests are all grouped in a certain section, not far from the sea, and at a slight elevation above sea-level, the pitch-pine in Spain is found scattered throughout almost all the country, the height above sea level varying from 600 to 1,300 meters (approximately 1,900 to 4,200 feet) and even higher. True it is that in Asturias and Galicia, there exist abundant pine forests near the sea, but these are not capable of being exploited commercially, as practice has shown, because they produce very little gum, that is, the product of the pine before being worked up.

The pine which is worked for gum in Spain is generally the maritime in its various classifications. Along the shores of the Mediterranean, the pine laricio is also found, but in very small quantities. The best pine forests are found within the center of Spain, not very far from Madrid, and principally in the provinces of Segovia, Avila, Vallodolid, Guadalajara and Soria. There are also some good pine forests in the provinces of Burgos, Leon, Tereul, Cuenca, Salamanca, Granada, Malaga, and also some in the provinces of Valencia, Castellon and a few others.

It is very difficult to estimate the extent of land covered by the pine forests, as they are very scattered. The Union Resinera Espanola works of its own property more than 60,000 hectares (about 150,000 acres) of good pine forests, but, apart from this, they also work many thousands of hectares which are the property of the state, of municipalities, or of individual owners.

The pine forests are found sometimes in flat lands, as occurs in the mesa of Castilla, sometimes in mountainous and broken country, as in Castilla already mentioned, Cuenca and others, and sometimes in hilly country, as in Andalucia. The Spanish pine, and above all that of Castilla, is vigorous and produces much gum, but it is not as straight and suitable for lumber as the pines of the French "Landes." In Castilla are pines which worked "living" produce more than five kilos (11 lbs.) gum per year. The pines along the Mediterranean shores do not produce so abundantly.

The pines are worked by the same system as in France, that is, the Hugues system, with pots of clay to receive the gum. The trees are generally worked "living" the first years, and afterwards "to death." While in France the gum is collected about six times a year, in Spain it is gathered a great deal oftener, that is, nine or ten times. The gum is very rich in turpentine, which we think is due to its being gathered oftener. The stills in Spain work by the mixed system, or with steam only, and today there are some stills which work in vacuum. Considering the stills with modern equipment, they compare favorably with the good French stills. Generally all the dry products are exposed to the sun in plates of zinc, and it is for this reason that at the end of the season there results a production of a very high grade colofonias (rosins) superior to the American waterwhite, and very few low grades. In Castilla especially, they manufacture colofonias extra-clear, which can not be competed with by the best French production. The climate being little rainy, free of clouds, the hot sun of Castilla favors much the production of the clear grades. The turpentine is fully equal to that of France, and is well distilled.

THE NAVAL STORES INDUSTRY IN GREECE

WHEN the war broke out in 1914 the naval stores industry of Greece, while of minor importance as compared with the industry in the United States, France or Spain, was in a flourishing state and expanding its operations from year to year toward the final goal of a maximum production that had been predicted for it of 22,500 barrels (50 gallons) of spirits turpentine and 70,000 barrels of rosins (480 lbs.). The war had an immediate effect on the industry. The political uncertainty into which the country was thrown, and the disorganization of its business and financial life, speedily affected the production of naval stores, which steadily declined. The exact crop figures of the war period are not available. Efforts to secure them from reliable sources were unavailing. From the government department at Athens was secured the following statement of Greek imports and exports of rosin and spirits turpentine for a term of years, in kilograms:

	IMPORTS.		EXPORTS.	
Year.	Rosins.	Spts. Turp.	Rosins.	Spts. Turp.
1909	20,000	12,038	2,056,472	767,627
1910	12,278	3,229	5,594,880	1,228,680
1911	16,947	13,861	7,802,452	1,561,654
1912	15,593	12,659	6,377,616	1,666,102
1913	27,117	4,933	1,843,942	790,227
1914	10,661	11,517	4,171,746	1,072,636
1915	15,842	1,531	3,669,239	820,630
1916	6,716	2,803	3,902,963	447,264
1917	65,825	4,777	2,809,525	....
1918	138,839	2,658	128,774	....
Jan.-June of 1919	4,742	410	1,090,636	149,487

1,015 kilograms equal a ton.

Special articles prepared for the Weekly Naval Stores Review in 1912 by leading naval stores firms of Greece gave the following information of the industry at that time. At the outbreak of hostilities two years later there had been but slight change in the production and general conditions remained unchanged, so it is presumable that on the restoration of the industry to its former position it will show few, if any, changes as to methods or markets.

The Departments of Attiki (capital Athens), Eubia, (capital Chalkis), and Argolis (capital Corinthe), possess large forests of pine trees. In 1902 only part of these trees were worked and very carelessly, and out of the gum extracted a small amount was made of a dirty black rosin, with many impurities, which was used by ship builders, and the turpentine for local consumption.

However, during the next ten years, a great improvement marked the industry. Year by year new factories were built at various places near the forests. These factories originally produced exclusively black rosin for rosin oil distillers, but about 1907 changed, one after the other, to produce clearer rosin, such as F, and after continuous improvements the industry in Greece became flourishing and progressive. Three qualities of rosin are now marketed: First quality, dark, corresponding to American grade B; second medium, corresponding to American grade F, and third light, corresponding to American grades G-H.

The Greek oil or spirits of turpentine is derived from Pinus halepensis Mill., whose turpentine gum in the fresh state yields about 20 to 22 per cent. oil of turpentine and 70 per cent. colophony, the remainder consisting of mechanical admixtures. But the bulk of the turpentine is not distilled from the gum of the pine tree direct. The gum is first added to the grape juices (in the case of red wines after the skins have been removed), to improve the keeping qualities of the wines, and also to impart to the wines the popular resinous taste. From the dregs of the wine containing the resin, the turpentine oil is then obtained by distillation, whilst the residue is worked up for colophony, or rosin, and tartrate of lime. This method of production explains the pleasant odor of the oil, reminding of wine. The examination of the Greek gum or crude turpentine gave the following result: Colophony, 78.57 per cent.; turpentine oil, 17.04 per cent.; loss at 100 degrees, 14.04 per cent.; ashes, 0.14 per cent.; acid number 149; ester number, 6; saponification number (determined by the hot process), 155.

By the year 1912 there was harvested in Greece from about 15,000,000 trees, by 2,300 collectors, a total of 11,300,000 oka of gum, which was divided as follows among the different provinces. (An oke, or oka, equivalent to 2.8215 lbs.)

Province.	Okas.
Attika	2,500,000
Korinth	2,000,000
Eubea	2,000,000
Megara and Theben	4,000,000
Skyros and Skopelos	400,000
Lokris	100,000
Pyrgos and Vostizza	300,000

Of these 11,300,000 oka (approximately 32,000,000 lbs.) there was used 3,000,000 oka (8,464,500 lbs.) in the perfuming of wine, a custom taken over from the old ages.

The balance of 8,300,000 okas of gum (23,400,000 lbs.) and furthermore 6,000,000 (16,900,000 lbs.) of resinous wine residue, which was left from the addition of gum to the wine, was worked into rosin and turpentine by twelve steam distilleries and twenty-three distilleries with open fire.

As 100 oka of gum yields on an average of 17 per cent. turpentine and 67 per cent. rosin, and as 100 oka of rosin wine residue yields 6 per cent. turpentine and 30 per cent. rosin, the following figures for the production in 1912 were arrived at:

Turpentine from the gum, 1,411,000 oka, equal to 1,808,902 kilos, or approximately 3,990,000 lbs. (11,400 casks of 50 gallons.)

Rosin from the gum, 5,561,000 oka, equal to 7,129,202 kilos (or 32,700 bbls. of 480 lbs.)

Turpentine from resinous wine residue, 360,000 oka, equal to 461,520 kilos (3,000 casks of 50 gallons.)

Rosin from resinous wine residue, 1,800,000 oka, equal to 2,307,600 kilos (10,600 bbls. of 480 lbs.)

Totals: Turpentine, 14,400 casks; rosin, 43,300 barrels.

The home consumption has been very small in both articles, the bulk of the Greek rosin prior to the war being exported to Italy, Austria, Roumania, England, Germany, Russia, etc. The rosin is shipped in bags of one hundred kilos gross, for net.

The distilling plants in Greece in 1919 are given as follows:

Province.	Steam.	Fire.
Attika	12	2
Halkis	2	1
Korinth	....	2
Argos	....	1
Tripoli	....	1
Patras	....	3
Others	1	4

In some provinces there are no stills, the gum produced being shipped for distillation, and gum produced in provinces where there are only fire distilleries is sometimes shipped elsewhere for distillation by the steam process.

NAVAL STORES IN PORTUGAL

(By Luiz B. Worm, Naval Stores Dealer Lisbon, Portugal.)

ROSIN and Turpentine are produced in Estremadura, Beira, Douro and Alemtejo provinces of Portugal.

There are about one hundred producers in the business.

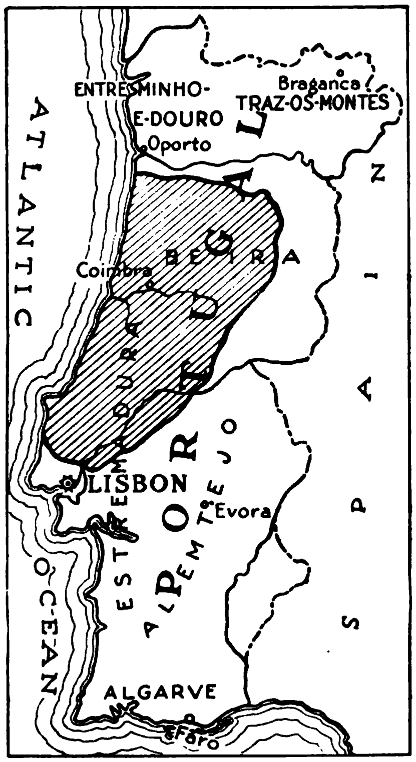
Part of them own their own timber and others lease the trees from landowners.

They follow the French system of production. The surplus of the crop not consumed in the country is mainly shipped to England and some to Belgium.

Shipments are made mainly from Lisbon but some from Oporto.

From an investigation made among manufacturers I have obtained the following details:

The average annual production for 1913-18 was about 6,000 tons of rosin and its proportion of turpentine.



Shaded Portion Shows Naval Stores Territory.

The production in 1919 was about 4,500 tons of rosin.

The 1920 season's production will be about 10,000 tons of rosin, as per manufacturers' intentions.

The consumption in Portugal is about 800 tons of rosin, being about 400 tons for soap making and the remainder for the manufacture of paper, varnish, etc.

HOW TO FIND VOLUME OR WEIGHT OF TURPENTINE

(By U. S. Bureau of Chemistry.)

In this country turpentine is sold almost exclusively by the United States gallon, which measures 231 cubic inches; in England it is sold by the hundredweight (112 pounds); and on the continent of Europe by the kilogram (2.2046 pounds), commonly known as the "kilo."

Turpentine shipped in tank cars is sometimes weighed and the gallonage calculated from the weight. In this case the commercial practice is to consider 7 pounds as a gallon. In most cases, however, this is incorrect, as only the very lightest turpentine at temperatures above 100 degrees F. weighs as little as 7 pounds per gallon. The exact weight per gallon of any lot of turpentine at various temperatures can be calculated from tables compiled by the Bureau of Chemistry, United States Department of Agriculture, which can be had on request.

If turpentine is purchased by volume, it should be paid for on the basis of the volume at the standard temperature of 60 degrees F. This may be determined by adding to the gauged gallonage, when the temperature of the turpentine is below 60 degrees F., or subtracting from the gauged gallonage, when the temperature of the turpentine is above 60 degrees F., at time of gauging, a correction found by multiplying the gauged gallonage by the difference between the temperature of the turpentine when gauged and 60 degrees F., and the product thus obtained by the factor 0.000525. If purchased by weight, it should be paid for at so much per pound or per 100 pounds.

In weighing a car of turpentine the stenciled weight of the empty car is usually accepted as correct. If a reliable railroad scale (known to be correct) is available, however, it is safer to weigh the car before and after loading, thus obtaining the true weight of the turpentine, as any error in the scale reading would appear in both the loaded and empty weight of the car. The weight of a railroad car as given in bills of lading is frequently incorrect by as much as 200 pounds, due to inaccuracy of scales, carelessness in weighing, or weighing cars which are wet or coupled to other cars not on the scales.

NAVAL STORES IN NORWAY

(By Wilh. Willumsen, Kristiania, Norway.)

ROSIN: Annual consumption about 4,000 tons, chiefly F and G grades. The bulk is of American origin, but the French and Spanish qualities are also finding a ready market.

The principal consumers are the paper and soap makers. As the production of paper is gradually increasing, the consumption of rosin is liable to do the same.

Norway has important pine forests but the production of rosin is not advantageous, the climate being too cold.

A considerable transit trade is going on with ports in the Baltic.

SPIRITS OF TURPENTINE: Annual consumption about 1,500 barrels. American, French and Spanish turpentine have all a good reputation, but buyers give the American the preference at even prices.

The Russian article is imported in very limited quantities, and only in case of need.

Mineral substitutes have a considerable market.

The sulphate wood pulp mills are producing a sulphate turpentine, which, when refined ,in some cases is used with success in the paint and varnish trade.

PITCH: The Norwegian annual production of pine tar is now estimated at about 30,000 barrels of 110 kg., but it is expected that same will decrease, many of the manufacturers after the war not being able to work with profit. The Finnish and Swedish imports, which before the war amounted to about 20,000 barrels of 110 kg. yearly, will probably again get a market.

There is no export to speak of, with the exception of Swedish tar in transit for the English market.

Pine tar is chiefly used in Norway for nautical purposes.

Obviously, then, the purchase of turpentine in tank carlots, at so much per gallon, based on a pre-assumed weight per gallon (commonly 7 or 7.2 pounds per gallon) introduces possibilities of two important errors in judging the quantity of the contents, one due to inaccurate weighing on railroad scales, the other to the difference between the actual weight per gallon of the particular turpentine and the assumed weight. As a matter of fact, a pure turpentine which weighs as little as 7 pounds per gallon, equivalent to a specific gravity of approximately 0.841 at 15.5°/15.5° C., is never obtained from present sources of American turpentine.

NAVAL STORES FROM THE VAST FORESTS OF OLD RUSSIA

THAT GREAT EMPIRE THE POTENTIAL SOURCE OF THE WORLD'S FUTURE SUPPLIES

(By Thomas Gamble.)

[Efforts to secure a special article dealing with Russian naval stores conditions failed. The industry and the trade are so distracted and demoralized that it seems futile at this time to look for information or to expect any movement toward a resumption of the manufacture of naval stores on anything approaching the old scale, let alone the improvement in methods that will come in later years. The following information from various sources throws light on the conditions surrounding the industry prior to the war, tells of the character of the products and of the progressive steps that were in contemplation. There is but one conclusion to reach in a survey of world-wide conditions as to future sources of naval stores, and that is that with the re-establishment of peace within the old Russian domains the forests of that vast territory must be looked to to furnish increasing quantities of spirits turpentine and rosins of an improved quality. One of the great developments of the industry in the future will be in Russia. As far as known it alone possesses sufficient forest areas to replace the shrinkage in such products that has come about through the destruction of the pine forests of the Southern States.—T. G.]

IN the disorganized and disintegrating empire that once was Imperial Russia, with its vast forests of pines or firs, the world may one day find the greatest source of its naval stores. With the productive capacity of the United States rapidly decreasing, with its end as a great source of supply fixed at from ten to fifteen years, with hardly any probability of the crops of France, Spain and Portugal ever going much beyond the maximum of their production for the current year, with India's possible production limited to 37,000 barrels of spirits turpentine and 100,000 barrels of rosins, with Greece and Algiers and Corsica and China and Japan and the South Seas and Mexico and Central America all exceedingly limited in their probabilities, and with other sources of supplies such as the Douglas firs of the Pacific slope of the United States and British Columbia and the pines of Arizona and New Mexico not such as to engender the hope that they can do much more than fill a bit of the vacuum in the world's needs caused by the destruction of the pine forests of the South, Russia, including Siberia, looms into a new significance. There labor promises to be relatively cheap in coming years, there lie the vast forests of resin bearing trees. With an honorable stable government re-established in the coming years, with outside capital welcomed and protected as it some day must be, with science invited and skill encouraged, the production of naval stores there may be many times multiplied, the quality of the output improved, repellant characteristics removed, and the uses of the products generally stimulated. Before the war broke out means to that very end were being adopted and projects were under way that eventually might have resulted in the Russian naval stores industry being placed on a much higher plane in the intelligence with which it was worked and the acceptability of its commodities. Expert minds were at work in the year or two just preceding the invasion of Belgium, efforts were under way to arouse attention to the importance of improved methods, sufficiently capitalized projects to insure success were proposed, and but for the years of hostilities, the wrecking of stable government, and the subsequent reign of the so-called Soviet government, Russia, either by this time or in the near future, bade fair to have become a better organized and more effective producer of spirits turpentine and rosins more closely approaching accepted standards and on a steadily expanding scale One cannot conceive of the future, even though it be delayed a decade, failing to find Russia making better use of this natural source of wealth and playing a more prominent part in the world's commerce in these commodities.

In a meagre way Russia today may be producing turpentine and rosins. Out of that welter of suffering and political, financial and industrial chaos comes little news of such a minor element of the national life. Two of the old producing sections, Finland and Poland, have been severed from the body of Russia and become independent governments. Elsewhere there is an article dealing with the production of tar in Finland. Before the war Finland was numbered in a small way among the resin producers. The production was never sufficient to make it of any importance and is reported to have ceased. Poland, including the province of Volhynia, was credited before the war with an output of about 2,000 carloads of rosins and turpentine, of the value of $2,400,000. In those now seemingly far off days, when the world appeared so bound together by the chains of commerce as to preclude the cataclysm that came, Kovel and Luck and Brest-Litovsk were the centres of this important trade. All fell into the hands of the Austrians in the first stages of the war. The Germans were said to have made great ravages on the Polish forests of pines (sylvester), to have cut down trees and dug up roots and by specially imported distilling plants obtained as much resin and turpentine as possible. Probably like much other war propaganda as to the efficiency that was being displayed in meeting current needs for raw supplies cut off by the blockade, this item of news was exaggerated for foreign effect.

AREAS OF PRODUCTION AND OUTPUT: On a visit to Savannah in November, of 1920, Mr. Israel Danischewsky, managing director of The Atlantic, White Sea & Baltic Co., of Archangel., London and New York, and before the war with offices at Moscow and Petrograd, and one of the largest handlers of the naval stores products of the Russian Empire, gave me the following concise information as to the industry and quantities of production:

"There are three distinct areas of naval stores production in Russia," said he. "Of these the Archangel district, in the northern part of the old Empire, with the port of Archangel as the outlet for the products of an extensive territory, in which tar, pitch and turpentine were made in considerable quantities, marketed the best qualities. The exact figures are not available at this time, but prior to 1914 there were exported between 75,000 and 90,000 barrels of tar, of 32 gallons each; 25,000 barrels of pitch, of 560 lbs. each, and of turpentine the equivalent of about 6,000 barrels of 50 gallons. Here it is essentially a peasant industry. Instead of boxing or cupping the trees, as is done in this country, the face of the tree is stripped of a portion of its bark, trees up to five or six inches in diameter being selected. The first year of operation the tree may be wounded in this way to a height of three to four

Pinus sylvestris, P. vulgaris, or P. nigra, the common pine or Scotch fir, occurs in many varieties, and is especially common in Alpine countries. This tree is the chief source of German, Finnish and Russian rosin. On distillation it yields a turpentine with a heavier odor than the American and French varieties, for which reason the distillate requires careful rectification.—The Distillation of Resins, by Victor Schweizer.

feet, and each of the next four years, the stripping process is continued two to three feet, so that by the fifth year the area stripped has moved up the tree as far as can be reached, or ten feet or more. Care is taken not to destroy the tree's life until the last year, when the stripping is made so broad as to girdle the tree. The gum that exudes from the wounded surface is not gathered frequently, as in the United States and France, but in October the surface is scraped and the gum brought together, mixed with pieces of bark and accumulated dirt, and is then refined, not as carefully as in the two great producing countries, but along the same general lines. The roots of trees that have been felled for some years, and the wood of others that have been treated as described, are destructive burned in small brick ovens of about 80 c. f. to 160 c. f. contents of wood, and by this process a fine quality of light brown tar and some turpentine is obtained.

"Another, and the largest area in which naval stores is produced, includes sections of what is now Poland and Lithuania, in the western central part of the old Empire. A third was in the eastern central part, commonly referred to as the Kazan and Vjatka districts, and from these two, which included a very great expanse of country, about 60,000 barrels of turpentine and from 125,000 to 150,000 barrels of tar were annually exported. Very little pitch was manufactured there. In the Kazan and Vjatka districts instead of ovens or kilns small metal retorts are, or were, used, sometimes six or more retorts in a row, in an oven, the wood being put in a wire basket in each retort, the fire between the retorts, the tar oozing out through a pipe at the base of each retort into a pipe extending the length of the entire plant and carrying it to the receptacles, the turpentine coming through a pipe from one end of the plant. This is a black tar, not as valuable as the Archangel district tar, and the turpentine has a lemon-like odor and is very pungent and sometimes distressing in its temporary effects on users. Another process used in this district is the extraction of turpentine by the drying of the wood by a slow heat in an oven, the wood then being used for the production of tar in the usual Kazan oven process. This makes a good turpentine but a black tar. The ovens bear the name of the district and are referred to as Kazanski ovens, and the turpentine and pitch are known under the name of "Tcheremishski," in the name of the inhabitants engaged in its manufacture.

"The district of which Minsk is the most important point varies from the others in a measure in the fact that the industry there is not so distinctly a peasant industry, large landowners being interested in a degree not known in the other districts. Lease rights are disposed of to those desiring the privilege to take out the roots of trees for the extraction of tar and turpentine. Some of these roots are of trees that had been cut twenty-five to fifty years ago, and are quite rich in resinous matter. In this territory a different process is again found. A boiler is erected on a brick base. This boiler is about fourteen feet high and 8 1-2 feet in diameter. The fire reaches about half way up the boiler. The turpentine finds its way out through a pipe above the fire line on one side, the tar through a pipe on the opposite side at the base. Of the output one-third is turpentine and two-thirds is tar, the proportion of turpentine, it will be noticed, being extraordinarily large. This tar, too, is inferior to the Archangel district tar.

"Up to within a year or two of the war large quantities of the Russian turpentine were shipped to England and there refined for its markets. Refining processes had been installed in Russia before the outbreak of hostilities and the exports to England had well nigh ceased. Large exportations of tar and pitch were made to Great Britain, Germany, Austria and Italy, and Germany also took Russian turpentine and handled it in a scientific way to improve its merchantable qualities. Considerable of the exports went by rail to the adjacent continental countries, but important shipments were made through Reval, Riga and Libau for the western producing territory, while the central eastern territory shipped also through Windau, Petrograd, and to some extent also through Archangel. The industry was improving its processes and but for the havoc wrought by the war it would have grown considerably in importance. In addition to the exports referred to considerable quantities were consumed in Russia, and Russia, besides, as American exporters are aware, was a large purchaser of American rosins.

"The industry has been continued in a lessened way under the conditions which have followed the war. The exports have been cut off but there has been, I understand, a home demand which has been met. The forest areas of old Russia are so enormous and the possibilities of the expansion of the industry under settled conditions of life are so great, that one must look to this as an important source of national wealth in years to come."

Soon after the war began a consular report from Commercial Attache Baker, at Petrograd, carried this information as to the industry in Russia at that time:

"**PITCH AND TAR**: The production of wood pitch and tar is a highly important industry of the timber districts of Russia. A large quantity of such substances is not only used for home consumption in Russia but is also exported to foreign markets. England alone takes over 100,000 barrels yearly of Russian pitch and tar. In normal times pitch is exported chiefly to England from Archangel, where it is one of the principal articles of trade, while turpentine has been shipped to Germany from the Baltic ports and overland. In recent years in Western Russia, especially near the Vistula river, large quantities of pitch and turpentine have been distilled from the stumps left after the clearance of woods, this having been in great demand in Germany on account of its good quality and low price. It has been estimated that the Russian forests produce yearly about 15,000,000 pounds of pure pitch, 150,000,000 pounds of tar, 5,400,000 pounds of resin, and 40,000,000 pounds of turpentine.

"Up to the present time the operating methods employed in this industry have been, for the most part, of a primitve character, and carried on in small establishments, where the owner is at the same time workman and salesman. There are few of these establishments with an output of over $10,000 per year.

"Pine wood is almost the only material used, the most resinous parts being the stumps and roots. To facilitate the uprooting and increase the resinous quality by decomposition the stumps are allowed to remain 10 to 20 years in the ground before removal, the best parts of the tree being the long vertical roots. The roots are dried in the air or in special drying rooms, as the products are not of such good quality when damp material is used. When using the trunks of trees the distillers select the parts that are accidentally filled with resin, especially where fungus has injured the tree and produced a mass of resinous matter.

"In making tar, the method of distillation ordinarily in vogue requires the digging of pits from 10 to 60 feet in diameter, similar to those that are made for burning charcoal. They are usually dug on the slopes of river banks. About 20 to 30 feet from the pit an excavation is made in the form of a ditch, the bottom of which is on a lower level than that of the pit. From this excavation a sloping trough is pushed into the center of the pit, a hole being made in the middle of the latter leading straight into the trough, and in this manner a funnel is made for the pit, the product flowing through it into pails. There is a tendency, however, for improved methods to be adopted, and simple but fairly efficient apparatus to be used.

"There is a large production of what is called 'polovinchik' (half-pitch), which is used as a dressing or greasing material for leather, this being the result of distillation of tar mixed with some birch or aspen bark."

Mr. James Watt, in his annual circulars analyzing imports into the United Kingdom, gives the importations of turpentine from Russia and Scandinavia and percentages as to total imports as follows, in cwts. (Percents. in parentheses): 1906, 4,139, (16.14); 1907, 4,910, (19.24); 1908, 1,849, (6.45); 1909, 2,752, (12.41); 1910, 3,777, (16); 1911, 4,344, (18.10); 1912, 2,798, (8.53); 1913, 1,769, (6.32); 1914, 1,210, (6.95); 1915, 211, (0.80); 1916, 1917, 1918, none; 1919, 562, (2.47).

Speaking of conditions just before the war, a correspondent at St. Petersburg wrote:

"The position with regard to wood products is not satisfactory. The reason for this is principally the backward state of the Russian producer from the technical point of view. The production of rosin and turpentine from the raw materials, which are so overwhelmingly abundant in Russia, is principally a peasant industry, particularly in the north, although in the southwest, in the Minsk district, it is getting more organized and under the control of captains of industry. Nevertheless, the manufacturers in the district named almost entirely fail to grasp the importance of putting the finished product on the market, or if they do grasp it, then they are either financially or mentally incapable of performing this feat. A high class turpentine is not unknown in Russia; but it is very scarce, and it is the low quality that not only rules the local market, but helps to spoil the market for the finer turpentines of other countries, to mix with which it is frequently sold. It has long been the subject of speculation by Warsaw people, who, as exporters chiefly to Germany and England, get control of most of the production of the Minsk district, a fair proportion of which is also sent down into the industrial districts in the south."

Early in 1914 the following somewhat comprehensive report was made on the naval stores industry in Russia by Prof. Maisit, of the Yarieff Pharmaceutical Institute Laboratory:

DEVELOPMENT AND PROCESSES OF THE INDUSTRY: "The tapping of the common pine (Pinus Silvestris) began in Russia in the year 1780, on the initiative of an Englishman and developed sufficiently quickly at first in the Vel district of the Vologod Government and then in the Shenkur district of the Archangel Government, that is, in the so-called Vazh area. For the development of the business a company of Archangel merchants was formed, at the head of which stood an Englishman. He controlled the export business, mainly to England, where at that time, there were difficulties in obtaining Boston (American) turpentine. At first resin (crude) only was exported, and according to Thomin, in 1783, the quantity thereof from Archangel port was 6,500 poods (105 tons). Then the working of (crude) resin into rosin and turpentine followed; but from tapping its pine trees the American product appeared again on the English market, and began to compete successfully with the Russian; and not only in England, for a large quantity of American rosin and turpentine is now imported into Russia, notwithstanding the high duties on the products of tapping. How important this importation is can be seen from the following table of the importation of the products of tapping over the European frontiers of Russia during recent years:

	Resin (Crude)		Galipot (Scrape)	
	Poods (36 lbs.)	**Roubles (2£ 1½s.)**	**Poods (36 lbs.)**	**Roubles (2£ 1½s.)**
1905	16,000	99,000	4,000	6,000
1906	18,000	116,000	6,000	9,000
1907	18,000	125,000	5,000	10,000
1908	21,000	139,000	6,000	13,000
1909	19,000	114,000	4,800	12,000
1910	25,000	141,000	7,500	18,000
1911	33,000	205,000	4,800	15,000
1912	31,000	186,000	5,900	17,000
1913	32,000	194,000	9,600	33,000

	Rosin		Turpentine	
	Poods (36 lbs.)	**Roubles (2£ 1½s.)**	**Poods (36 lbs.)**	**Roubles (2£ 1½s.)**
1905	1,645,000	1,645,000	38,000	230,000
1906	1,664,000	1,996,000	43,000	283,000
1907	1,873,000	2,436,000	47,000	320,000
1908	2,086,000	2,711,000	46,000	244,000
1909	1,539,000	2,117,000	41,000	117,000
1910	1,695,000	2,886,000	46,000	266,000
1911	2,015,000	5,096,000	55,000	326,000
1912	1,844,000	4,791,000	56,000	332,000
1913	2,203,000	4,688,000	69,000	415,000

"The importance of the demand for the products of America is explained, on the one hand, by the development of factory industry in Russia, and on the other by the stagnant and even declining Russian turpentine industry. According to a review of the chief branches of industry and trade (1910), in the Vel and Shenkur districts there were a number of factories working siera (thick resin that has hardened on the tree, corresponding to the galipot of France, the scrape of the United States) as distinguished from the semi-liquid resin, into rosin and turpentine—ten belonging to peasants and dealers and one to the Treasury. On the same authority, in these factories from 40,000 to 55,000 poods of rosin (1,440,000 to 1,980,000 lbs.) and about 5,000 to 10,000 poods of siera turpentine (180,000 to 360,000 lbs.) were made. Thus the quantity is far inferior to the corresponding importations from abroad. But, apart from the Vazh district, the tapping of pines for resin, rosin, and turpentine is hardly done.

"Only a short time ago resin was produced in Finland, in the Veaborg, Nyuland, and Vasask Governments, where there were turpentine manufactories. Between 1871 and 1875 as much as 10,000 poods of resin (360,000 lbs.) were dispatched from these places; but in 1891 only 1,518 poods (54,648 lbs.), whilst at present the pine is no longer tapped in Finland, and all the factories that worked on resin have been closed. But tapping in other districts of Russia, for example, in some parts of the Kostrom and Tver Governments, and in the southwestern districts, is only done for the purpose of obtaining good material for tar distilling, and the resin, if it is collected, is of very poor quality, and is only of local value. Even in the Vazh district the pine is tapped now not principally in order to obtain resin, but for the purpose of obtaining a wood tar half product for further dry distillation, and the resin obtained with it is a kind of by-product. Therefore, in the collection scrupulous care is not taken, and so we have a low quality in the products of tapping.

"The collection of resin takes place once, frequently twice, a year; therefore it loses a large quantity of turpentine, and becomes a semi-solid siera (scrape). Besides this, in collecting the siera many substances get mixed with it, such as pine bark, acicular leaves, sand, etc., which not only affect the quality of the siera, but also the turpentine prepared from it, and particularly the rosin. The well-known falsification of siera with various foreign substances, of which the least offensive is small ice, in the winter time, is no less an evil. According to eye witnesses the mixture of this latter sometimes reaches 50 per cent. or more. All this, taken together with the relatively simple methods of distillation, have established for Russian resin, rosin, and turpentine a far from brilliant reputation. However, I should add here that this, if true respecting siera and rosin, it is far from correct respecting turpentine as can be seen from the fact that this last is often sold, and is even exported abroad under the name of American or French turpentine. The abundance of pine forests in Russia on the one hand, and the ever-growing demand for resin and turpentine, and particularly rosin on the other, has stimulated a number of people to inquire what profit there would be in tappng acicular leaf trees, particularly the common pine in Russia, and what is the quality of the products obtained, by observing all the conditions abroad? Experiments were carried out and are carried out, partly on private initiative but partly, also, on the suggestion of the government or other bodies."

POSITION OF THE INDUSTRY BEFORE THE WAR: In 1912 a report on wood distillation in Russia stated that "although the position of the Russian chemical industry is a fairly steady one in respect to its most important features, the condition of the important industry of wood distillation is one of almost complete unorganization, which, in view of the practically unlimited supply of raw material and the great demand for the finished product the world over, is almost uncomprehensible if we remember that wood distillation in Russia is an old industry. Notwithstanding this last-named fact, the distillation of wood remains almost everywhere in the country, where it is engaged in, a home industry.

"Although in certain branches of it there are a few houses equipped on quite a modern basis, the production for the greater part is carried out in a large number of home or semi-home plants. These sometimes pour on to the market a too large supply of goods

that do not correspond to the demand in respect to quality, and as they are not served by an efficient system of agents, the producers are frequently reduced to a state of complete impotence in face of their buyers.

"This refers to practically all primary and secondary products of wood distillation, including acetic acid and its salt, wood spirit and the like. But coming particularly to turpentine, tar, and rosin, the report deals with these in considerable detail; amongst other reasons because they form an important group in the export lists of the country. The average export of turpentine and turpentine oil for the period 1906-10 amounted to 780,000 poods (28,080,000 lbs.) The figure given for 1911 is 817,-000 poods (29,412,000 lbs.), valuing 2,-511,000 roubles. All the turpentine exported comes under the heading of oven turpentine. It is of relatively inferior quality, and is usually exported as a half product and has not an individual importance of its own, on the world's market. As a substitute, it is governed by the position of the American and French turpentine markets. Its export increases and its value appreciates as American turpentine is scarce and vice versa. However, for the past three or four years this branch of industry, which is of permanent interest for Russia, in view of her wealth of forest land, has shown some signs of improvements. In some cases the technical equipment of the factories has been made quite efficient, including distillation by steam with a very accurate, fractionation of the distillates, so that some sorts of Russian turpentine are not inferior to any foreign product on the market. Unfortunately the sale, particularly for export, remains in its original unsatisfactory condition. The buyers, sometimes, by making advances in cash, get control of all the goods made by small producers. These goods, which are of varying quality, are exported to the foreign refineries, and as a rule it is only thereafter that they are made use of.

"The Russian export of wood tar and pitch suffers as a rule from the same troubles as does turpentine. Notwithstanding some variations in the annual export between 1906 and 1910, during which the average made 1,717,000 poods, (61,812,000 lbs.), the weight exported in 1911 was 2,101,000 poods (75,636,000 lbs.), value 1,792,000 roubles (of £2 1½s. each). A more rational technical equipment of the industry, along with a better export system and a more uniform quality, with improvement of tare, would considerably improve this feature of Russian forest economy.

"A position apart is occupied by turpentine, which is obtained from resin. This product is obtained in a manner similar to that of the fine French turpentine, and it is claimed by Russian authorities to be equal in quality to the American or French article. Hitherto this product has only been won in the Vel and Shenkur districts, and has amounted only to 10,000 to 20,000 poods (360,000 to 720,000 lbs.), whilst the production of rosin by this process has been insignificant in quantity, say 100 wagons a year, or a little more.

"The insignificance of these figures is the more obvious in the light of the quantities of this quality of turpentine imported in the year 1911, namely 89,-000 poods, whilst in the years 1909, 1910 and 1911, rosin was imported to the extent of 1,539,000 poods, 1,696,000 poods and 2,014,000 poods, respectively, the last valuing 5,095,000 roubles. This is no new feature. The importation of rosin during some preceding years exceeded even that of 1911. The report continues, showing the market movements of American rosin in Russia. But these being passing phases need not be dwelt on excepting to observe that for want of a well equipped turpentine and rosin industry Russia is paying away immense sums to foreigners for goods that might quite as conveniently be made at home.

"This view is appreciated to some extent by the Russians, and endeavors are being made to produce turpentine and rosin from the resin in other parts of the country than those named above. In Siberia, on the Volga, and in the Baltic district expeditions are engaged seeking suitable localities for establishing the industry of tapping the trees and distilling the resulting liquid. An idea exists that the Russian climate is hardly suitable to the industry. Apparently considerable success attends the extraction of the resin from trees and rhizomes. It is proposed by some to, by some means or other, use the rosin that remains in the rhizomes of the trees. In rough terms these means consist in the turning of the tarry acids into a corresponding soap. Theoretically the object is attained. And if the practical difficulties be overcome the Russian market should be placed in possession of a quantity of goods the trade in which opens practically unlimited prospects."

LACK OF INITIATIVE IN INDUSTRY: The next year (1913) correspondence from Archangel at the close of the shipping season (November) stated that the exports from there for the season were 74,281 casks tar; pitch, 26,581 casks; turpentine, 6,165 casks. The buying countries for these goods were chiefly England, partly Germany and Holland. "It will be observed from the figures that the progress of turpentine production, at all events for export, is still very limited, and the idea of refining the article for the foreign markets has not yet taken firm root in the neighborhood of the White Sea, although turpentine of a crude sort is produced largely in the northern provinces of the country, and the government is establishing schools or model turpentine factories in order to teach the people how to produce turpentine that will hold its own with the imported foreign article for home consumption, if not for export.

"A good deal has been said recently in Russian turpentine circles respecting the adoption in Russia of the French system of tapping the trees. But whatever the reason be, the industry cannot yet be said to have caught on, although from time to time it is referred to as being on the point of taking a firm position in Russia. The truth may be that the weather interferes with tapping as done in France; but it is more probably the lack of initiative on the part of the Russian industrialism that leaves the foreign market as well as his own, at the almost complete disposition of the foreign producer of high class turpentine."

During the war the production of spirits turpentine and rosin by the French process was undertaken in a small way in the Caucasus. The high prices made even the small production profitable. On the estate of the Grand Duke Nikolai a small plant produced, in 1915, it was stated, 1,122 poods turpentine (40,396 lbs.) and 4,620 poods rosin (166,320 lbs.), insignificant as to quantity but significant as to possibilities, considering the great forests available.

INFERIOR QUALITY OF TURPENTINE AND ITS BETTERMENT: The virtues and weaknesses of Russian turpentine were analyzed by Dr. F. M. Perkin in a paper read before an English trade body in 1913, which conveys some idea of the difficulties that have surrounded its marketing in competition with the American or French articles and indicates that in coming years, with scientific distillation, Russian turpentine may more and more make provision for the shortage in American production. Said Dr. Perkin:

"Russian turpentine is almost invariably manufactured by destructive distillation, and generally this carried out in an extremely crude manner. The bulk of it comes to this country (England) unrefined and has to be refined here if it is in any way to compete with genuine American turpentine. But be it ever so well refined, it is not possible to obtain the same price for it as for American. Personally I am of the opinion that prejudice against Russian turpentine is too strong. Undoubtedly, when it is used in the crude state, particularly in ill-ventilated rooms, it is apt to produce nausea and headache, and makes the eyes sore. When, however, it is well refined, and the paints are mixed with it without the user being aware of the fact, it is extraordinary what little effect it has on the men. I have examined turpentine sold as genuine American which contained nearly 75 per cent. of refined Russian turpentine. In using this turpentine no complaint has been made by the painters. In another case I supplied painters with refined Russian turpentine—it was par-

ticularly well refined; they used it for interior painting, and there were no complaints. There is no doubt, however, that the method of refining is of the greatest importance.

"The question is whether it can be refined so as to give a really good product at a profit. The question actually is, how much is lost in the refining process, and what does the refining cost? In the first place, most crude Russian turpentines contain resinous and pyroligneous bodies. These can be removed by treatment with alkali, and this treatment to a large extent removes the penetrating odour, but not entirely. Subsequent distillation in steam or in a vacuum vastly improves the product, but there may be a very considerable residue of high boiling products. Probably in taking the treatment right through only about 90 per cent. of the turpentine is obtained as refined turpentine, and very often less. Part of the residue, however, is saleable, but fetches only a fraction of the cost of the original turpentine.

"Some years ago I was interested in the refining of Russian turpentine. The process we adopted was first to get rid of the resinous and other acid bodies, and then to distil in a vacuum with the aid of live steam. The still had a heating worm through which steam was passed, and another coil which was perforated. The temperature of the turpentine was first raised to about 70 deg. C., and then live steam at about 10 lbs. pressure was let into it. A vacuum of about 27 ins. was maintained, and the whole distillation was carried out at about 70 deg. C. It was necessary to have very efficient condensing in order to maintain the vacuum. The turpentine was fed in continuously at about the same speed as the distillation took place, and the steam so regulated that about the same volume of turpentine and water was condensed. Every now and then the residue had to be drawn off. This was done without breaking the vacuum, but for the time—a few minutes—the supply of steam and fresh turpentine was interrupted. By this means, by using ordinary care, a very highly refined turpentine was obtained. The still was capable of dealing with several tons per day. So far as I know this was the first time that live steam had been employed in a vacuum on a large scale. It is now being used in America, I understand, for refining glycerine.

"Of course, the refining processes for Russian turpentine apply equally to wood turpentine obtained by destructive distillation in America, Sweden and elsewhere. Attempts are now being made in Russia to improve their methods, and to a certain extent tapping is resorted to. The turpentine prepared in this manner is said to be equally as good as the French or American. Bearing in mind, the enormous extent of the pine forests in Russia it is a great pity that more is not done in this direction.

"However carefully Russian turpentine is refined, it always behaves in certain directions differently to turpentines which have been produced by the distillation of oleoresins. After keeping for some time, the burnt tarry smell to some extent always returns. This, of course, is not noticed if it is employed for painting shortly after it has been refined. I had at one time a number of samples of both American and Russian turpentine which had been kept for some years. These had resinified to a greater or a less extent, but the appearance of the Russian was more tarry than the American and the samples were thicker.

"One great difficulty met with in Russian turpentine is that the crude product varies so much in quality. I believe it is partly refined in Russia and that certain fractions are taken out, and often what comes over is a mixture of higher and lower fractions. It is consequently a very difficult matter to decide whether a parcel is 'merchantable' or not, the paler grades being sometimes more difficult to refine than the darker."

In two books published this year (1920) I find significant items as to the almost boundless wooded areas of Russia. In his 'Timbers and Their Uses,' Wren Winn says that 'European Russia possesses 422307,000 acres of forest land, or nearly one-third of the whole country. Poland has 6,706,000 acres, Finland 50,-498,000, and Caucasia 18,666,000 acres. There is in addition an enormous tract of forest land in Asiatic Russia.' In 'Potential Russia,' R. W. Childs states that 'Russia is a world timber supply. Of its eight and a half millions of square miles, thirty-nine per cent. is in timber. Including Siberia there are over 900,-000,000 acres of woods."

RUSSIA'S ENORMOUS FORESTS: In "The Resources of the Russian Empire" in the Geographical Review, April, 1916, Mr. E. K. Reynolds says: "To the south of the tundras is the great coniferous forest belt, which stretches from Finland to the Sea of Okhotsk. At its western end, where it is more settled, this is perhaps the most beautiful part of the great Russian plain. The countryside is dark with the shadows of the fir trees, but frequently shot with the light, lithe trunks of silver birches. The aspect of the land, too, is slightly rolling in parts, and cradled between these slight elevations there are thousands of charming little lakes fringed around with reeds.

"In Siberia, the forest region is called the taiga, which means a vast, more or less unknown surface, covered with dense, impassable forests. Heavy underbrush, fallen trunks, and endless quantities of game are its chief characteristics. Comparatively little of the taiga has been reclaimed, that is, turned into farming land. One reason is that the climate here is so extreme and the winters so endlessly long. The cold is so intense that an occasional tree splits open, making a noise like the report of a pistol. It is so cold that the warmth from the body of a bird, as it rises from the ground, will leave a streak of steam. Added to this is the annoyance from the swarms of insects characteristic of Arctic summers. The pioneer settlers had to live in houses filled with smoke to get any relief from them, and they had to build huge bonfires in the pasture lands to protect the cattle.

"Yet this taiga is one of the greatest treasures in Russia's long list of natural resources. In round figures it is said to represent ninety million acres of magnificent timber. That is less than one-tenth of all the timber resources of the Empire, which are estimated at one and a quarter billion acres. In addition to the great northern forest belt, there are extensive forests on the Urals and the Caucasus. The trees of the taiga are pines, firs, spruces, larches, and allied species, intermingled here and there with various kinds of birches, aspen, and a few other leafy trees. At its western end, in the central provinces of Russia, the taiga abuts upon the mixed deciduous forest which covers all of cool-temperate Europe. Oak, maple, elm, ash, and poplar are the chief trees. The Mediterranean vegetation of southern Crimea and the eastern Black Sea littoral contains such species as the cork-oak and the yew.

TURPENTINE AND ROSINS IN GERMANY

THE SITUATION IN REGARD TO THEM AND SUBSTITUTES IN USE

(By V. K. Bury, of Berlin.)

[Mr. V. K. Bury, of Berlin-Friedenau, is a German student of international political economy, and has occupied himself for some time with questions concerning the field of "Naval Stores." He is well versed in matters pertaining to German economics, and especially in the changes brought about by the world war in the foundations of provisioning industry. Mr. Bury is at present occupied with a scientific treatise dealing systematically with the international trade in "Naval Stores." Apart from this, he is a collaborator in an important work which will soon be published in Berlin, dealing with "German War Economics," which work is edited by the celebrated political economist, M. Sering professor at the University of Berlin.]

THE problem of substitutes only opened up to its full extent for Germany as a result of one of the developments of the war, namely, the English blockade, which made it impossible for the country to cover its heavy requirements for resin and turpentine oil from abroad as formerly. Although the mean import for domestic use amounted to about 80,000 tons resin and 25,000 tons (of 1,000 kilos) oil of turpentine during the closing years of peace, imports soon sank to a minimum, despite the fact that in the first year of the war all connections had not yet been interrupted with the United States.

However, even in the last decade of peace times, Germany, notwithstanding the ample supply from the inexhaustible American sources, showed a certain tendency for independence from foreign sources of raw material. This was due partly to the heavy increase in price, which commenced with the formation of the trust in the American market, and partly to the success of the German chemical industry, especially in the field of coal research.

Thus with the invention of coumarone resin a certain basis had been established for the synthetic composition of turpentine resin. However, practical results were lacking. The coumarone resin was an inferior substitute, and could not compete sufficiently with the native American resin.

Only the necessities of war created a change in the situation, for the actual basis for the production of substitutes, that is to say, profitableness, was established by the isolation from foreign sources of supply.

On the other hand, the utilisation of the domestic pine woods, extending over an area of about 5 to 6 million hectares, and which had never been exploited previously, owing to the unfavorable climate, only began in the year 1916. Moreover, in spite of a very complete and exhaustive organization (within the period of two years, they succeeded in perfecting the method of extraction from the primitive box system to the American cup system and the Risse system), with an average yield of 5,000 tons, only a small part of the requirements could be met.

In this connection it must be borne in mind that the extent of the demand, it is true, was limited by the effects of the war, but this did not apply to its diversity, for the war industry, especially the munition industry, had created numerous new applications.

Against this diversified use, the chief characteristic of which consisted in the fact that the various purposes of application made various demands on the substitute, we find the striving to create substitutes, which could as far as possible be adapted to the different purposes of application.

It was possible to divert the demand for resin, in the munition industry, newly created, to other substances, namely, to a pitch, which was extracted from brown coal or lignite, which contains resinous constituents in great quantity as compared with mineral coal or anthracite. Thus this use for rosin in munitions, which had only been created by the war to any great extent, was eliminated, practically speaking.

It was now possible to prepare coumarone resin, the essential constituent of which is coumarone (coumarone, in turn, is a hydrocarbon accompanying the solvent naphtha, a by-product in tar distillation)—also a light, springy resin in all variations, which was capable of taking care of great demands to a high degree. Thus a product was created, on a favorable raw material basis, for the main raw material was found in coal, which essentially assisted in coping with the resin famine. Notwithstanding this favorable position in regard to raw material, no success was attained in materially increasing the production above 10,000 tons per year. An explanation for this can be found in the fact that only small quantities of coumarone are obtained from the sulphuric acid treatment of the solvent naphtha.

Aside from the lack in quantity, coumarone resin did not answer all requirements as to quality, for reasons embodied in the varied chemical nature of natural resin and synthetic resin. Thus the hopes entertained in regard to the possibilities of application in the paper industry, did not materialize. Natural resin (resin from the pine tree) remained an absolute necessity, although many other substitutes were found, to which further reference will be made. This was also true of the brewing industry. Here it was absolutely impossible to find any substitute for natural resin, which is used for the pitching of barrels.

The conditions in the second largest sphere of consumption, that is, the varnish industry, were different. In this industry it was possible to dispense entirely with natural resin. Coumarone resin attained a similar importance in the remaining numerous smaller spheres.

However, there were also extant the large original spheres for the use of the material, the paper industry, the brewing industry, the cable industry, the varnish industry and a large number of other industries of minor importance. The resin oil industry had already been eliminated at the beginning of the war. In view of this large sphere of use chemical science tried to find substitutes and succeeded in developing and perfecting the invention of the coumarone resin by careful researches.

The fact that coumarone resin is used to a large extent to supplant resin clearly appears from the circumstance that as early as the end of 1916 coumarone resin was taken over by public administration, that is to say, was requisitioned by the government.

In addition to these two substitutes, namely, lignite tar pitch and coumarone resin, there are a number of other substitutes. Fir resin, which similarly to pine resin, was obtained in Germany and also came from Sweden in large quantities, could replace turpentine resin only to a small degree.

In the paper industry, a special chemical process (Zellkoll-Amalprocess) entered into consideration as a substitute for resin. This was based on the invention of sizing paper by chemically composed substances. Although this invention has been put into actual practice, it never gained great importance, as the execution of the process is connected with great technical difficulties.

Regarding the sphere of application of oil of turpentine, basic changes had also taken place here by the addition of other sources of supply as already, in

peace times, resin oil had been used to a limited extent in connection with the neighboring Russian places of production instead of oil of turpentine. Resin oil now played a decisive role, in view of the small supply of oil of turpentine available, and which was held for a time for the camphor industry. This resin oil was gained partly in charcoal burning, and partly in the manufacture of cellulose, as a by-product. By improving the refining process, it became possible to obtain a practically transparent, odorless liquid. In addition, there were used as solvents those chemical substances, which had also previously constituted somewhat of a substitute for oil of turpentine, such as benzol, acetone, etc.

Now if it be desired to gain a proper picture of the part all these substitutes will play in the future supply of Germany, the economic condition of Germany must first be considered.

The question as to whether these substitutes, which undoubtedly are inferior in quality to the natural raw material in certain respects, can maintain themselves in a normal economic life with a sound rate of exchange, in competition with an unweakened, unabating American competition, cannot be entered into here, inasmuch as it is impossible for Germany to attain such a stage of convalescence of its economic conditions for many years to come. This is solely a question of profits, and has no practical bearing upon the near future. Rather, Germany will be forced for some time to come to limit its imports in resin and oil of turpentine as in all other raw materials as far as possible, and to exploit the domestic sources of raw material to the greatest possible extent. For a long while it is not conceivable that Germany will, to the same extent as before the war, enter the world market as the principal customer for American products, especially as heavy increases in prices have also occurred here.

The conditions governing the problem of substitutes are similar to those relating to the obtaining of resin from German woods. Despite the depredations resulting from the war in German forestry, and which are still being continued as a result of the present famine in wood and the results of the peace treaty, in both instances the firm resolve exists, not to again allow these domestic sources of raw material to dry out. Thus not only a combination was arrived at in the industries utilizing resin, for the purpose of taking over the resin supplied by the German Forest Departments, but an association was also formed by the principal consumers and the producers of benzol from which coumarone resin is obtained.

Nevertheless, in this way but a small part of the German needs can be satisfied—we estimate only 20%. Germany is therefore dependent upon the American resin as before. It will therefore depend entirely on the remaining parties to the Versailles treaty whether or not Germany will ever play any significant part as a consumer in the world market.

GERMANY'S EFFORTS TO PRODUCE ROSINS AND TURPENTINE DURING THE WORLD WAR.

(By the Department of Oils and Fats of the German Government.)

BEFORE the war the production of rosin was known in Germany only from the pine tree, but this was very considerably reduced in the last years on account of the importation of the cheaper American and French rosins so that it hardly came into consideration for the total requirements of industry.

After the outbreak of the war it appeared that the supply of rosin on hand was comparatively small and that also the domestic production of rosin from the pine tree was insufficient to cover the requirements of rosin for the consuming industries.

Attempts were therefore made to produce rosin from the fir trees, as considerable quantities of these were available in Germany. The production of rosin from this tree was up to that time unknown in Germany and nobody had any experience as to how this could be arranged to best advantage.

The first attempts to produce rosin from the fir were made by the "War Commission for Vegetable and Animal Oils and Fats in Berlin," in the year 1916. As the American method could not be considered under our conditions the Austrian method was taken as a guide. Although the result in the beginning was not a bad one, means and ways were sought to obtain better results. Before long we commenced to produce rosin according to the method of Forest Commissioner Splittstoesser, i. e., by the use of the brush-hook. With this tool the trees were scratched in the so-called "fish-bone" manner. The heavy cuts in the trees were thereby avoided, inasmuch as cups were used in gathering the gum.

In spite of the big difficulties which were encountered on account of the labor conditions, the difficulty in securing tools, cups, as well as barrels, the result was a comparatively good one.

In some instances three to four times more rosin was produced than in former years. Hereby a great deal of the requirements of the army for war purposes, as well as the quantity required by industries, could be filled.

In addition to this came the success in securing materials which offered consuming industries considerable substitutes for the natural rosin. Besides the "Cumarone" rosin, which was being manufactured in larger quantities and better qualities than formerly, came especially into consideration the artificial rosins, which offered a very good substitute, and in many cases gave German industries a perfect equivalent for natural rosin.

Not to be forgotten is also the productions of rosin from the fir roots and wood, which were used by some factories with the best results. In addition to this, the already well known simple distillation of root and wood, particularly in the occupied territories in the East, was undertaken for the manufacture of pine oil. The results of this were also very good. (During the war it was stated that special distillation plants had been sent to the forests of Poland, Austria and Russia.)

So, taken as a whole, a great deal of the necessary rosin has been assured for German industries with certain restrictions as long as rosin cannot be secured abroad at materially lower prices than is at present the case. (1920).

ROSIN PRODUCTION IN PRUSSIA

(Written for Annual Number of Naval Stores Review in 1912 by the Prussian Minister of Agriculture, Domain and Forestry.)

For the production of rosin there is only one tree in Prussia which is to be considered, and this is the "Fichte" (abies excelsa.)

However, this tree yields in comparison to the Southern pine, only very limited quantities of rosin. While many kinds of pines will yield per tree seven kilograms and more gum, the "Fichte" will yield only about one-half a kilogram. Nevertheless there has been quite some rosin industry in the eighteenth and the beginning of the nineteenth centuries, especially in Thuringia, Black Forest and Vosges.

The privilege of making rosin was given in Thuringia against a very small yearly fee. In this manner there was established a certain right of several persons to produce rosin, which became very dangerous for the forests in general.

The different governments tried, therefore, to buy back as much as possible the privilege of rosin production, so that the whole matter became again official property; especially as the production of rosin amounted to so little, and hampered by the competition of American rosin the production stopped entirely about the middle of the last century.

During the years 1857 to 1866 steps were taken to re-establish rosin production in Thuringia in a manner that only the very oldest trees be used. This trial, however, remained without success. The yield was too small and on account of rather high expenses it was impossible to compete with the American products.

On account of the possibility of bad consequences for the best part of the tree, particularly so far as the Prussian "Fichte" is concerned, and especially as it is hardly to be expected for rosin and turpentine to climb up to such a high level as to make rosin production again profitable in Prussia, there is hardly a chance for this industry to be taken up again in Prussia.

PRUSSIAN MINISTER OF AGRICULTURE, DOMAIN AND FORESTRY.
Berlin, Germany.

THE GERMAN NAVAL STORES TRADE

The following figures as to the German trade in rosins and turpentine prior to the war were prepared for this book by the Department of Statistics of the present German Government.

IMPORTS OF TURPENTINE INTO GERMANY IN TONS* (2,240 LBS.)

Year.	From France.	United States.	Total All Countries.
1900	807	22,584	28,130
1901	948	22,615	27,550
1902	1,440	21,309	26,380
1903	2,874	19,720	27,108
1904	2,033	20,504	27,561
1905	4,950	18,207	27,890
1906	3,744	3,986	27,374
1907	3,255	3,593	29,347
1908	3,276	24,639	32,949
1909	4,576	22,526	31,888
1910	4,308	18,496	28,282
1911	4,589	16,935	27,326
1912	2,646	23,639	30,455
1913	4,530	26,996	35,029

*Ton equivalent to approximately six American casks of spirits turpentine.

IMPORTS OF ROSIN INTO GERMANY IN TONS* (2,240 LBS.)

Year.	From France.	United States.	Total All Countries.
1900	9,504	91,247	102,454
1901	11,670	93,808	106,651
1902	10,207	78,247	89,602
1903	12,727	92,138	107,268
1904	11,974	91,694	105,933
1905	15,510	76,565	94,481
1906	12,999	69,292	89,714
1907	11,013	90,294	112,324
1908	12,778	107,820	129,826
1909	17,754	71,432	94,343
1910	18,158	80,993	108,964
1911	18,361	83,630	111,609
1912	21,953	88,302	113,481
1913	16,896	77,010	96,265

*Ton equivalent to approximate'y four and a half American barrels rosin.

EXPORTS OF TURPENTINE AND ROSIN FROM GERMANY, IN TONS* (2,240 LBS.)

Year.	Turpentine.	Rosins.
1900	1,647	22,892
1901	1,846	19,168
1902	1,641	15,312
1903	1,999	20,209
1904	1,860	20,692
1905	1,701	21,033
1906	1,105	19,189
1907	1,142	24,956
1908	1,415	27,650
1909	1,242	21,781
1910	1,403	25,257
1911	1,371	23,748
1912	1,614	17,060
1913	1,889	25,803

*Ton equivalent to approximately six American casks of spirits turpentine and four and a half American barrels of rosin.

THE NAVAL STORES INDUSTRY IN BRITISH INDIA

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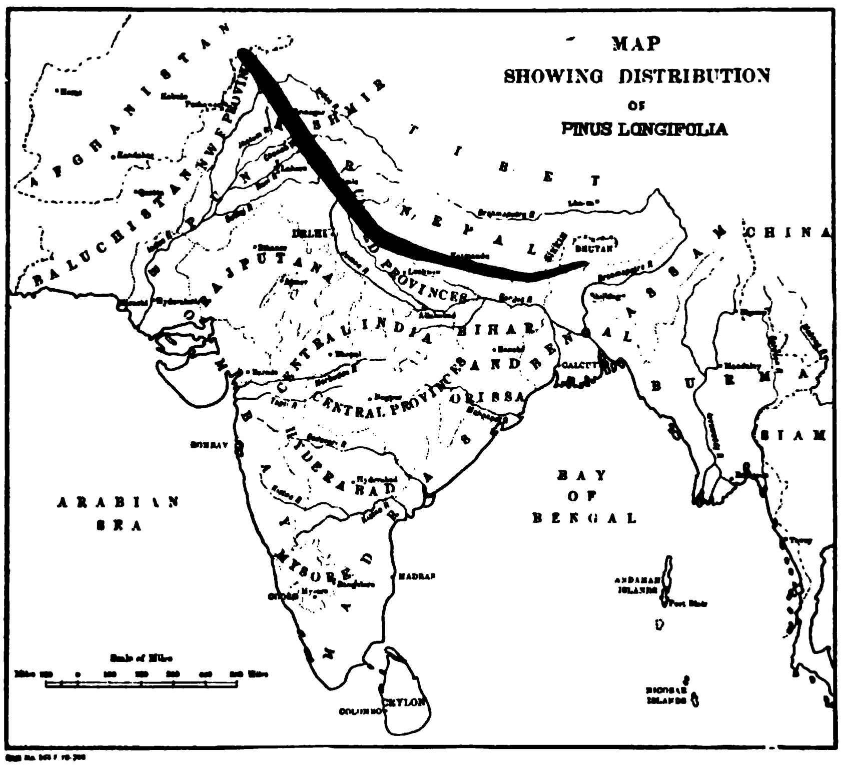
THE generally backward condition of industries in India is reflected by the small consumption of rosin and turpentine in the country, which averaged for the past thirteen years, ending March 31, 1919, 16,000 barrels of rosin (in terms of American barrels of 500 lbs. gross, 20% tare), and 6,000 barrels of turpentine, including turpentine substitutes (in terms of American barrels of 50 gallons, that is of 42 Imperial gallons). Prior to 1905, the rosin and turpentine was nearly all imported and of American origin, either direct or via the United Kingdom, the rosin being shipped in the well-known American rosin barrels, while the turpentine was chiefly shipped in cased tins, there being two 4-gallon tins to each wooden case.

However, India is now developing industrially at a rapid rate and is fully resolved to make the best use of its raw products, consequently a short account of what its Forest Service is doing in developing the naval stores industry may be of interest. Work in this line, until quite recently, has been in the experimental stage, but now modern methods and modern plants are rapidly beginning to show results. Thus for the last financial year (ending March 31, 1919) India succeeded in producing over 11,000 barrels of rosin and some 3,500 barrels of turpentine towards her own requirements. It is calculated that by October, 1920, she will be independent of outside supplies of naval stores and will then be able to turn her attention to neighboring countries where rosin and turpentine are wanted.

The most accessible belt of pines in India is that situated at the foot of the Himalayas at elevations of from 2,000 to 6,000 feet and extending roughly from the Kabul river on the west to the Ganges river watershed on the east, as marked in the accompanying map. The area of forest covered by this particular pine, the long-leaf pine, or Pinus longifolia, is estimated at some 3,000 square miles, but a large part of this tract is inaccessible and until more roads are made cannot be touched for resin tapping operations. So far only 97,000 acres (say 150 square miles) in the Punjab and the United Provinces have been worked, so there is plenty of room for expansion, as in addition to the Pinus longifolia, there are considerable areas of Pinus excelsa, Pinus Gerardiana, P. Merkusii, and P. Khasya in the Himalayas and in the hilly tracts of Assam and N. Burma which yield good oleo-resins. These areas are also deficient in communications and roads and therefore progress, of necessity, will be slow. At a conservative estimate British India should be able to expand her naval stores industry to an annual output of 54,000 barrels rosin and 18,000 barrels turpentine within the next ten years or so, the maximum probable annual supply being 100,000 barrels of rosin and 37,000 barrels of turpentine, though such a production will only be attained after many years of strenuous organization and development.

It is now nearly a quarter of a century since resin tapping was started in the N. W. Himalayas and from the very start the conservative and well-known French cup and gutter system has been in use, the number of channels made per tree varying with the girth of the tree, though trees marked for felling are especially heavily tapped. This work is now well organized and as the system is well known a detailed account would be superfluous. The tapping areas are divided into blocks, these blocks are grouped into depots of 25,000 to 30,000 channels or cups, each laborer being allotted a section containing 1,000 blazes. These blazes he refreshes regularly six times a month and delivers the resin daily to his depot, where it is transferred to 4-gallon empty kerosene tins, which, when full, are promptly soldered up. The Indian tapping season extends from March to November, and in that time the channels are gradually increased in height by some 20 to 22 inches. At the end of each season's work the gutter and cup are raised to within 3 inches of the top of the channel in preparation for the next year's work. In the fourth and fifth year of tapping the laborer requires a light ladder to reach his pots. At the end of the fifth year the old chan-



The territory shown in black is the turpentine belt of India, probably 1,300 miles long, about 10 to 30 miles in width, from which some day considerable of Asia's needs of turpentine and rosins will be met.

nels are abandoned and a fresh crop set up. In the course of a season the average collection of crude resin by a laborer is 40 cwts., while expert men can make it as much as 60 cwts. As each tree has on an average 1½ channels and as there are twenty tapped trees on an average to the acre, the average yearly yield per channel is 4½ pounds of crude resin, per tree 6¾ pounds of crude resin, and per acre 1 1-5 cwt. of crude resin. The daily collection of resin by a section laborer during the season varies from 7½ pounds to as much as 55 pounds, the yield depending on climate, especially temperature and amount of rain, nature of crop, etc., the daily average being about 16 pounds. The photographs reproduced show some forest scenes during resin tapping operations.

The areas of forest land under the Indian Forest Service and in the large Indian native states are worked on scientific lines and are carefully protected against fire and over-felling, while the reproduction of the principal forest species is insured by the provisions of forest working plans prepared by trained forest officers. In this way continuity of policy is assured and wasteful methods eradicated, while the forest property increases in value year by year. About 25% of the total area of British India is in the charge of the Forest Department, that is some 250,000 square miles, and as the Great War has amply demonstrated the national necessity for controlling a supply of forest products, a "go-ahead" and progressive forest policy in India is assured and is in rapid process of development.

A glance at the map will show that India is a country of immense distances and this has very strongly influenced the local policy in regard to the manufacture of Indian rosin and turpentine. For instead of bringing the factories to the turpentine areas, the crude resin is transported long distances to the factories, this enabling the factories to be laid out on a big scale and insuring cheap administration and the standardization of the manufactured products. Thus in the Punjab the crude resin is conveyed by men, mules, camels, pack-bullocks, bullock carts and motor lorries to railhead, and then by rail to a central turpentine factory near the capital of the Punjab, Lahore. Similarly, in the United Provinces all the crude resin is sent to the Bareilly central factory.

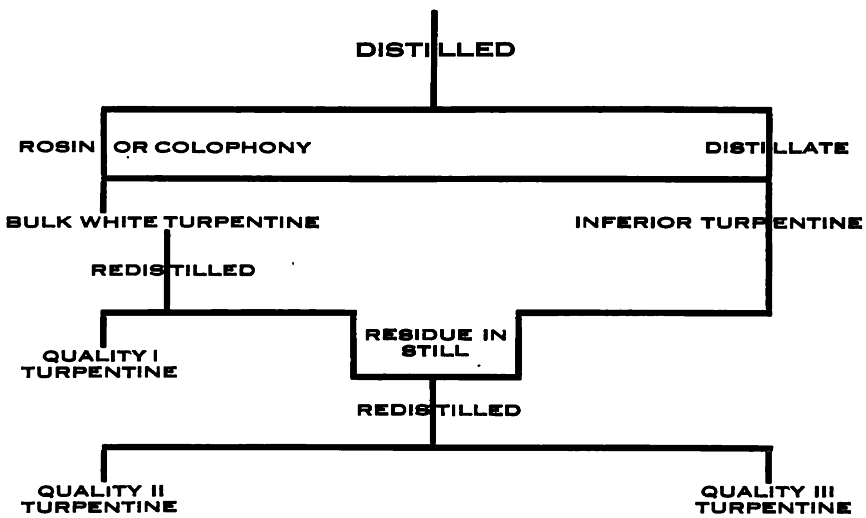
At the factories, which are now equipped with modern French steam distillation plants, specially modified and adapted to deal with Indian crude resin, the crude resin or gum is distilled into its components, the percentages by weight being:

Turpentine	20
Rosin	70
Dirt and Impurities	3
Water	7
	100

MR. A. J. GIBSON.

The Indian Government being the owner of the forests now being worked for crude resin, the industry is a Government monopoly, until such time as absolutely standard products are manufactured, when, presumably, private enterprise will be allowed to step in. The present cost of production f. o. r. at factories is, as far as can be ascertained, for turpentine sixty-seven cents per gallon packed, and for rosin nine dollars thirty-three cents per barrel packed (500 lbs. gross), the costs of production being equally divided over the rosin and turpentine, as each of these products is responsible at present for half the gross revenue, while the rate of exchange is assumed to be the normal one of a dollar to three rupees, though actually at the time of writing the rupee is worth approximately 50 cents (Ds 3.50 equal Rs. 7 equal £1). The Indian naval stores packages are slightly different from American ones, the Indian rosin barrel being 450 to 470 lbs. gross with a 10% tare, approximately, while the turpentine is put up in 5-gallon G. I. drums, such drums weighing 6½ to 11 lbs. each. The photographs here reproduced give a few views in the turpentine factories referred to in this article.

Though the organization and training of the unskilled labor available for resin tapping gave and will give considerable trouble until permanent bodies of "turpentiners" such as are found in the Southern States of America and in the Landes district of S. W. France are formed, yet it has to be admitted that the main work and research in the Indian naval stores industry took place in the factory and in the factory methods. It was realized fairly soon that the turpentine of P. longifolia was a complex turpentine, containing in addition to pinene, unknown terpenes which gave to the turpentine very undesirable commercial properties. Persistent work and research solved the problem and a commercial system of distillation and redistillation has been devised which produces a quality No. 1 turpentine, able to compete on its merits with American. Strangely enough the turpentine from P. excelsa, Gerardiana and Khasya are far more tractable, but the inaccessibility of these pine belts prevents their resin being commercially exploited just at present. The chart below illustrates the commercial process of distillation of P. longifolia gum now adopted as a provisionally standard process: Crude resin melted, specific gravity adjusted by addition of turpentine, allowed to rest and filtered by gravity method. Then—



A typical view of forest in India of Pinus longifolia, Roxb., the long-needled pine, chir. A large conifer of the Himalaya and Siwalik hills at 1,500 to 7,500 feet. Wood light reddish brown, moderately hard, used for building, common furniture, tea-boxes, beats and general carpentry. Is now being utilized on a fairly large scale for sleepers after antiseptic treatment. The wood is available in large quantitis. The resin of this species is now extensively tapped in the United Provinces and the Punjab for the manufacture of rosin and turpentine.

On careful fractionation in the laboratory the turpentine of P. longifolia was shown to be a mixture of four terpenes:

L. Pinene and B. pinene......60.8%
d. Carene 14.8%
Longifolene 10.2%
Residue and loss......14.2%

The laboratory work on the subject is not yet completed and the d-carene fraction presents specially interesting and novel features to the chemist. To the practical turpentine man in India the chief interest of the research lies in the fact that the ready oxidation of Indian P. longifolia turpentine is due to the presence of this hydro-carbon, which also imparts to it its characteristic, somewhat sweet, smell. Quality I Indian turpentine from the resin of P. longifolia has a specific gravity of 0.865, gives a 90% fraction going over under 170 degrees C., has the B. P. standard of acidity with alcoholic K O H solution and has a residue on boiling off a sample on a water bath of under 1%. Indian rosin calls for no special remarks. The French system of manufacture adopted insures a very clean, brilliant and transparent product, while the method of collecting the crude resin in vogue results in a very uniform resin and no "scrape," consequently the bulk of the year's rosins are "pales," generally of "K" and "I" grades.

Experimental work is in progress in the manufacture of rosin oils, wheel-greases and pitch. The stump wood of P. longifolia has been destructively distilled to yield a tar indistinguishable from Stockholm tar and accepted in the Calcutta market as such. A trade in this commodity is being built up.

The marketing of the products described proceeds along accepted lines. Agents have been appointed at the principal seaport towns and a sales agreement and the periodical fixation of sale prices between the United Provinces and the Punjab Forest Departments have removed all danger of misunderstanding or friction on that score. Paper factories, soap factories and varnish concerns, etc., are the chief consumers of the rosin, more or less as in the U. S. A. In one respect, however, the Indian rosin trade is unique, for something like 9,000 cwts. of rosin a year are used in the sophistication (to a permissible and recognized percentage of 3, but generally to considerably more) of manufactured lac or shellac, which is practically an Indian trade monopoly, bringing in something like rupees 40,000,000 a year (say 13 1-3 million dollars.

In conclusion the writer may be allowed a small personal touch in referring back to 1912 and vivid memories of a pleasant trip to Savannah and the State of Georgia—seeing and studying American "naval stores" conditions at first hand, and also to his meeting with the editor of the "Naval Stores Review," who was all assistance and kindness in the writer's interests. That memory makes it all the more pleasurable to prepare this necessarily brief article on the "naval stores" industry of British India for fellow-workers across the Atlantic (or would the Pacific be more accurate in point of geography and time), with whom we are, in this, as in many other industries, in friendly rivalry.

The following additional information as to the naval stores industry in India is obtained from pamphlets by Mr. Gibson and Mr. Smythies, published by the Forest Department of that country:

THE production of rosin and turpentine by distillation from the resin of the low-level Himalayan pine, Pinus longifolia, has made rapid strides in India in the last few years and the Forest Department factories at Bhowli, United Provinces, and Jallo, Punjab, have been hard put to it to meet all the demands on them, as imports of rosin and turpentine (mainly American, either direct or via the United Kingdom) have been reduced very greatly (1919) since the war began. Modern methods, too, have succeeded in standardizing Indian rosin and turpentine as manufactured at the Jallo factory, and the United Provinces are copying

both the plant and the system in their new factory now under construction at Bareilly. The industry, consequently, shows considerable promise for the future.

The Ordnance Department has made use of the rosin for shrapnel shell filling and varnish making to a considerable extent, in the last two or three years, while without the Indian turpentine, railways, and other large paint-consuming concerns, would have had great difficulty in getting their essential paintwork done. Rosin is an important constituent in paper and soap-making, while rosin-oil, the product of the destructive distillation of rosin, is the main ingredient of a class of largely used lubricating greases. There is thus every reason to continue developing the industry along sound commercial lines to meet the demand in India for articles so far largely imported.

For the year ending June 30, 1919, the United Provinces and Punjab Forest Departments were working 2,485,222 blazes in their forests for crude resin, over an area of 92,493 acres, the production of turpentine being 141,407 gallons and of rosin 58,500 maunds (1 maund equals 82 4-7 lbs.). The subjoined table contrasts the figures of 1917-1918 with imports plus Indian output in the past ten years.

Imports and Production of Rosin in India During the Past Ten Years.

ROSIN (Maunds)

Financial Year	Imported	Indian Output	Total
1907-08	104,160	6,609	110,769
1908-09	79,520	9,811	89,331
1909-10	87,640	10,449	98,089
1910-11	56,840	9,054	65,894
1911-12	93,472	12,268	105,740
1912-13	85,424	27,963	113,387
1913-14	62,703	27,429	90,132
1914-15	34,052	33,862	67,914
1915-16	43,071	47,149	90,220
1916-17	25,701	59,523	85,224
1917-18	44,094	60,938	105,032

TURPENTINE (Gallons)

Financial Year	Imported	Indian Output	Total
1907-08	222,560	16,086	238,646
1908-09	253,570	23,592	277,162
1909-10	194,760	24,105	218,865
1910-11	197,720	17,051	214,771
1911-12	266,443	27,756	294,199
1912-13	251,079	60,249	311,328
1913-14	193,937	58,803	252,740
1914-15	142,438	78,489	220,927
1915-16	86,700	111,835	198,535
1916-17	80,000	125,663	205,663
1917-18	140,772	136,052	276,824

Six maunds equal barrel 500 pounds. Indian output in 1917-18 accordingly equivalent to about 10,150 American barrels of rosin and 2,720 barrels (50 gals.) spirits turpentine.

There is enormous scope for expansion; thus, the area of Government-owned Pinus longifolia forests which could be tapped can be estimated at close on 420,000 acres, while forests in Indian States would double this figure. In addition, large areas of other species of pine in the Himalayas of the Punjab, United Provinces, Assam and the hills of Burma will become available as soon as communications are improved or developed. One may put the ultimate maximum annual production of Indian rosin and turpentine at 600,000 maunds and 1,850,000 gallons respectively. With such an output at its command, India could probably meet the demands of Africa, the Straits, China, Java and Australasia as well as her own, but it will require many years of effort and organized expansion before such yields can be thought of, far less be attained.

So far only the resin of the chir pine has been dealt with commercially. This pine covers some 1,500 square miles in Government forest and another 1,800 square miles in native States, while the blue pine, the Khasia pine and Pinus Merkusii, the resin of all of which has been well reported on, extend over some two hundred, eighteen hundred and twelve hundred square miles respectively, all under control of the Forest Department. It would not be safe to assume that even half of the Government owned area will ultimately prove workable, but these figures are sufficient to show that the revenue now derived from this industry is only a fraction of the return which may one day be realized.

The industry is, therefore, one to which in recent years the Forest Department has rightly devoted a good deal of attention, and though expansion must be gradual, yet the prospects are there and it only requires effort along sound commercial lines to reap a good harvest. Any forest industry which yields such satisfactory financial re-

Pine Tree in India, Showing Resin Pots in Position.

Indian Laborers Refreshening Channels in Pine Tree.

sults and yet leaves the main source of forest wealth, namely the timber, a realizable asset, is deserving of the most careful study.

The crude resin reaches the factory in soldered up 4-gallon kerosene tins, weighing on an average 20 seers (41 lbs.) net. As the resin gets very hard and solid in the cold weather, the tins, when necessary, are placed in batches of 200 in a steam-heated chamber where the temperature of 70 to 80 C. soon liquifies the resin sufficiently to enable the contents to come out easily. The tins are then removed, cut and opened neatly along three sides of the lid and emptied into a tipping wagon. Any resin adhering to the sides of the tins is washed off by means of steam jets. The tins are then taken outside the factory and are repaired and resoldered, to be sent back ultimately to the resin forest depots in roped bundles of 32, weighing just over a maund. The cost of repairs and return journey averages three annas a tin. As new tins are at present hardly procurable at one rupee each, the economy resulting is self-evident.

The full tipping wagons are lifted on to a trestle bridge to be conveyed to the mixing vats. The trestle bridge is necessary to get the resin to the correct height-level for the future stages of manufacture. The vats are fitted with helical mixers worked by hand power.

As the whole subsequent process of manipulation and distillation depends on the correct method employed in the mixing vats, some rather long quotations from the writer's report on "Modern Resin Factories as Applied to India" are, perhaps, permissible.

"In France it has been found that even the very best methods of filtration (whether cold hydraulic or hot ordinary) leave in the resin a fine, almost impalpable dust, called poivre—pepper, which causes even the best made colophony to be somewhat opaque. It was found, further, that heating the crude resin to between 50 to 80 C., the temperature varying (with the quality of the resin being treated, and stirring slowly until the mass was completely melted and liquid, and then allowing the whole to rest, caused the contents of the mixing vats to separate into distinct layers. The lighter resin with such impurities as chips of wood, bark, pine needles and so on, would form the upper layer, while water, with the earth, pebbles and such like heavier impurities would form the lower layer. During the period of rest the fine "pepper" or sand in suspension in the resin would by gravity sink to the bottom, leaving the resin as pure rosin dissolved in turpentine on the top, together with floating chips of wood, bark and needles, which are easily prevented from going over into the next stage in the process. Mixed with the water would be lumps of earthy resinous matter, "scrape" and fluid heavy resin containing next to no turpentine; these would all find their way to the lowest part of the V forming the bottom of the vat. So much for the description of the functionof the mixing vat; the careful heating of the resin while slowly mixing; a period of rest; the separation of the mixture into two layers. But the last stage depends on the difference in specific gravity of water and resin; these densities are very proximate and when the two substances are moderately heated the water sometimes has a somewhat lower specific gravity and the difference in density is insufficient to cause a separation into two distinct layers. An extreme case is where the resin contains much rosin and little turpentine: in such a case the water would float over the melted resin and the operation as described would be a hopeless failure. There are two ways of overcoming this difficulty:

"(a) By reducing the density of the resin by adding to it miscible liquids with much lower specific gravities, or (b) by increasing the density of the water by adding to it calculated quantities of soluble salts. For a fairly detailed description of the many methods, which have been tried and have failed in France, reference is invited to Monsieur Vezes' book 'L'industrie resinere landaise sa technique actuelle,' 1912. It is sufficient to say here that for the former purpose, alcohol, petrol and white spirits among others have been used with poor success, owing to the initial cost, and the cost of the recovery processes; in the end, most manufacturers adopted the method of adding turpentine from a previous distillation (generally 160 kgs. of oil to the contents of each mixing vat) and found the method most practical, especially when dealing with 'scrape' and heavy resin. For increasing the density of the water, cheap soluble salts such as sodium chloride, sodium sulphate and sodium carbonate are employed, but from a practical point of view their use is complicated by the danger of introducing into the plant active oxidizing agents, which would cause deterioration of the products. In the Punjab the addition of turpentine oil will first be tried, as this will involve very little additional expense and the plant and the products will be kept pure and clean; for it has to be realized also, that though nothing is easier than to complicate the distillation by adding various ingredients, their total elimination (outside a chemical laboratory) is sometimes a matter of great difficulty, and the trade will not countenance adulteration, however innocent in its origin, and this will be only more strongly the case when the Indian naval stores industry has to produce articles up to standard specifications and quality, as will undoubtedly have to be done if the industry is to be placed on a permanent sound commercial basis."

That was written in 1914. The addition of turpentine from a previous distillation has proved eminently satisfactory at Jallo and the rosin has turned out to be of excellent purity, transparency and quality.

From the mixing vat the filtered resin goes into the storage tank, and from the tank measured quantities go

into the steam elevator. The still and the steam jacketed rosin trough are mounted on wheels.

It was in perfecting the actual distillation process that difficulties had to be overcome. In France a perfectly straightforward distillation, with a gradual increase of temperature being checked by an ever-increasing volume of injected steam into the still, works well. The inexperienced and generally untrustworthy Indian distiller, however, injected steam too violently and resin was carried over into the condenser worm. Consequently a catch-still was introduced. But the ordinary catch-still condensed all the best turpentine, contaminated with resin, so to overcome this it had to be heated by an internal steam-coil. Then it worked satisfactorily. The turpentine from Pinus longifolia is compound turpentine, the smaller half having a high-boiling point. Efforts had to be concentrated on getting the maximum quantity of oil to come over the lowest possible temperature. This was achieved by fitting a large pressure-converter to the main steam pipe of the still, and reducing the boiler pressure of 112 lbs. to 72 lbs. in the still. The result was an increase of quality No. 1 oil from 1.1 gallons per maund of crude resin to 1.5 gallons, which, on an output of 32,000 maunds per annum, represents an increased revenue of Rs. 16,000 a year. That small improvement pays the greater part of the B-Establishment charges of the year of the Resin Forest Division.

For the actual technique of this part of the operation another quotation from the writer's above-mentioned report is necessary:

"The still in Ropar's plant—French 'alambic'—is comparatively small, with its maximum charge of 100 gallons of resin, that is, 11-12 maunds, considering the daily output it is designed to deal with. Its main features are its huge dome and large carry-over pipe to the condenser. The dome is fitted internally with baffle-plates and a sieve, both designed to prevent the mechanical carrying over of resin and rosin in the condensing plant. A small air-valve is also fitted in the dome and its operation will be described when the actual process comes under review. The still is steam-jacketed and fitted internally with a large number of mainly vertical steam pipes, connecting with the steam jacket, thus insuring the resin being broken up and coming into contact with a maximum heating surface, a very important point in designing a resin still, owing to the very poor heat-conductivity of the resin and rosin. The steam injector discharges into the still at the very bottom and was originally designed to force a jet steam vertically down; however, this generally gave rise to a great ebullition, so in the Punjab still the lower end of the injector tube has been fitted with a number of horizontally radiating hollow arms, closed at the ends, and pierced in one row of

The Steam Shed and Condenser.

perforations along one side only, and always along the same side, so that when steam is injected a strong horizontal circular motion is given to the contents of the still, with the result that the level of the charge has no tendency to lift and danger from excessive ebullition is averted. The working of the still is quite simple. When the fresh charge of resin is let in, the resin is brought up to a temperature of between 110 to 120 degrees by means of the steam-jacket and pipes. This occupies three or four minutes. A moderate jet of steam up to 8 kgs. per sq. c. m. (about 114 lbs. per sq. inch) pressure, is then allowed to enter and the temperature gradually ascends to between 150 and 160 degrees, and is kept from going further by gradually increasing the amount of injected steam, for as the distillation proceeds the available quantity of turpentine decreases and the separation of the resin from the last part of the turpentine oil requires a considerable temperature. When the layer of oil in the distillate sample glass is only a few millimetres thick, steam injection is stopped and the last traces of oil and water are driven off by the heat of the steam-jacket and the tubes, the steam here being at 112 ibs. pressure, enabling a high temperature to be obtained. The boiler is also worked at this pressure as a general rule. A steam-trap in the lowest part of the steam-jacket enables the condensed water in the jacket and pipes to be disposed of." The subsequent operations can again be best described by reference to the report, slightly modified, here and there, to allow for changes in the last four years. "The turpentine vapor and steam leave the still via the dome and the carry-over pipe, and enter the condensing apparatus where they are condensed. This condensing apparatus is of a peculiar design, adopted firstly, because of the ease with which repairs can be carried

The Rosin Dipping Shed.

out; secondly, because of the ability to create a small vacuum in the still by its use, and thirdly, because of an automatic device by means of which air is largely excluded from the inside of the apparatus, whether it is in use or not. The last reason is the most important one, for it enables distillation to be carried out with air largely excluded, and prevents internal oxidation of the copper worms while the plant is at rest, this being the most prolific source of the green coloration of Indian turpentine oil. The condensing tank or vat is circular and of large dimensions, and is designed to work with a consumption of about 2,000 gallons of cold water per hour, but by adopting a suggestion of the writer's, the hot water from the condenser in the Punjab plant is made use to feed the boiler, thereby not only saving fuel, but reducing the total hourly water consumption from 2,300 gallons (requirements of boiler and condenser tank) to 2,000 gallons (requirements of condenser only).

"The actual condensing apparatus consists of two horizontal parallel iron annular pipes of large diameter, one at the top and one near the bottom of the condensing tank. Connected to these, at equal intervals, are eight vertical spiral copper worms of medium and equal diameter throughout their length, but considerably constricted where they join the lower annular pipe. Below the last named is another annular pipe parallel to it and about 3 to 4 inches away. This pipe has perforations along its upper side, and being connected to the cold water inlet pipe of condensing tank the result of the design is to have a constant play of small jets of cold water on the lower surface of the condensing pipe just above.

This creates local condensation, and its large diameter, together with the constrictions in the lower ends of the worms tends to create a downward suction which imparts itself to the dome of the still, creating a small vacuum. The designed condensing surface of this apparatus is very large and the liquid products of a whole distillation can be accommodated if necessary without any overflow; this insures a thorough cooling off of the distillate before it reaches the separator, and thus a prolific source of loss of turpentine is avoided. The use of large diameter worms is not recommended because of the very indifferent results obtained by their use in practice when compared with tubular condensers. Any small diameter worm or pipes with well-proportioned strangulations designed to prevent too rapid a flow of the distillate are calculated to give good results, provided the total condensing surface is sufficient. As to the third reason advanced. The lower annular condensing pipe communicates with the separator for the discharge of the distillate by means of a gooseneck pipe, the levels being so arranged that a short column of liquid prevents the entry of air into the condensing apparatus, whether the still is working or at rest. In the morning, before starting the day's distillation, a small tap at the bottom of the gooseneck bend is opened and the worms are completely emptied. Possibly, but not probably, the liquid may be colored green."

"This brief description of the condensing apparatus will, it is hoped, suffice to draw attention to its advantages. The writer, before placing the order for the Bordeaux plant, was greatly impressed by the theoretical advantages of tubular condensers as compared with ordinary worm condensers, but in practice they are most troublesome; they contain anything from 700 to 800 tubes and if a tube cracks or starts leaking and has to be replaced the labor involved is tedious and troublesome and quite beyond the capacity of the ordinary Indian 'mistri.' In the condensing

Native Coopers at Work in India.

Tinsmiths Closing Turpentine Drums.

apparatus adopted the break-down of a worm will cause but little difference to the working of the plant. It is disconnected from the flanges, and the liberated flanges are covered by simple circular plates and bolted on, the whole work not taking more than an hour or so. The condensed distillate is collected in a separator—French 'bassin Florentin'. In the separator the difference in the density of the turpentine and water is made use of to the effect a very perfect separation, which enables the pure oil to be pumped direct from the separator to the bulk storage tanks, though a rest in an intermediate cistern for forty-eight hours is advisable. The action of the separator is simple. The water automatically discharges a constant level through the goose-neck pipe provided, while the floating oil flows from compartment to compartment in the separator (there are generally four divisions or compartments) depositing the flocculence it contains (French 'limen') till in the last compartment it is quite clear and limpid and fit for pumping to the bulk storage tanks.

"The rosin from the still is let out by means of a very large diameter valve situated below the still and flows directly into the steam-jacketed colophony filter trough, (French 'waggonet') where it passes through three superimposed filter trays, the uppermost coarse and strong, as it has to bear the strain of the rapidly flowing rosin, the middle one of medium fineness, and the lowest of a very fine woven metallic cloth. The trough, as already mentioned, is mounted on wheels and can be wheeled away from the building along rails as soon as the still is empty. The troubles arising from the dense colophony fumes are thus obviated. The still being empty, the rosin valve is thoroughly cleaned by scouring it with a jet of steam conveniently placed for this very purpose (for otherwise the valve would stick at the next opening), and is closed again, the still then being ready for the next charge of resin. The air-valve on the dome of the still is for use during the drawing-off of the rosin. There being a slight vacuum in the still, the state of equilibrium produced might possibly prevent the outflow of the rosin, a condition of affairs which would be remedied at once by opening the air-valve. The device is a precautionary one, and in practice will not be used much, it is thought." Nor has it been.

THE commercial exploitation of the resin of the Indian pines serves a wide range of subsidiary industries. It provides rosin for shellac making, soap manufactures, paper concerns, oil cloth, linoleum, sealing wax, printing inks, electric insulation, gramophone records, and wheel grease. And it also provides turpentine which is the chief thinner and solvent employed in the paint and varnish trades, a mordant in print goods manufacture, the basis of synthetic camphor, and an ingredient of boot-polishes, embrocations and liniments. This field is wide enough in peace times, but is considerably expanded in war time by the rosin used in "setting" shrapnel bullets in shells.

It is now (1917) well over a quarter of a century since forest officers in the northwest of India began to realize the potentialities of the wide pine belt along the foothills and lower slopes of the Himalaya. Many of them being French-trained, it was not surprising that the splendidly organized tapping of the maritime of the Landes should serve them as a model, and so from that very start the conservative cup and lip method in use in France was adopted, thus insuring the best possible

Turpentine Bulk Storage Sheds.

yield of resin with the minimum risk of injury to the tree.

In the last five years in the United Provinces more especially, extensive and successful organization has brought the harvesting of the resin to a high state of efficiency. Mr. E. A. Smythies' interesting pamphlet on the "Resin Industry in Kumaun" (Forest Bulletin No. 26, 1914) is aavilable for those who wish to study the question further.

The work of setting up a crop of pots (or cups) and lips preparatory to tapping pine trees for resin is simple, when properly organized, and the resin collection in the forest offers exceptional opportunities to the surrounding villages to utilize the old and the young for earning excellent wages.

The bark of the tree to be tapped is first of all lightly smoothed, then, as close to the base of the tree as possible, the bark is entirely removed so as to expose the sap-wood on a strip some 6 inches high and 4 inches wide. A galvanized iron lip 6 inches wide by 2 inches deep is driven in at the lower end of this strip or gash and an earthen pot made by local village potters, is hung below the lip, being kept in position by a nail or a hardwood peg. This preliminary work is done in the winter months.

The tapped forests are grouped into depots, sub-blocks and blocks for purposes of control, the unit of work being a section of 1,000 blazes (equivalent to an average of 700 trees, spread over 25 to 30 acres of forest) in charge of a tapping coolie, and the unit of control being a depot taking the produce of about 25,000 blazes or channels.

The tapping coolie at the beginning of the tapping season, some time in March, cuts away the sapwood on the already prepared strip to a depth of about ½ inch to ¾ inch, thus severing the resin ducts and channels in the wood and causing the liberated resin to flow down the cut surface over the guiding galvanized lip into the cup below. These severed channels clog after a while, and the whole art of tapping lies in refreshening the blaze at fixed intervals, gradually extending it upwards till at the end of the seven or eight months embraced in the tapping season the blaze should be about 24 inches long and the coolie in charge of the section of 1,000 blazes should have delivered 45 to 55 maunds net (say 2 tons) of resin in his depot.

Work goes on in this way for five years, the lip and cup being raised annually with the increase in height of the blaze, so as to reduce the distance the resin has to flow before reaching the cup, as the resin oxidizes (and deteriorates commercially) very rapidly in contact with air. In the fifth year of tapping the coolie has to be furnished with a light ladder to reach his work. After five years the blaze is left alone and a fresh one is started, and so the tree continues yielding resin and uninterruptedly for some 60 years out of its normal life of a century and a quarter. Trees under 3 feet girth are not tapped and above this girth the number of blazes varies with the size of the tree. Those trees destined to be felled within five years of the time of starting tapping are specially heavily worked for their resin, amort, to quote the French expression. With this necessarily brief account, the forest operations connected with the harvesting of the resin have to be left and the factory processes and the markets taken up in review. The cost of the resin delivered at the factory site varies from Rs. 2-4-0 to Rs. 3-4-0 per maund net.

It was in the factories and in the selection and devising of manufacturing methods best suited for the distillation of the Indian pine resin that the Forest Department found its hardest task, a task in which the Forest Research Institute at Dehra Dun and the Imperial Institute, London, gave much helpful advice and assistance. America, thanks to the happy chemical constitution of its principal pine-resin, produces a turpentine which stands in a class by itself, though manufactured in the most primitive, direct fire-heat apparatus, French manufacturers found, but not till they had learned by bitter and costly experience of adverse trade criticism and adverse markets, that an apparatus good enough for America was not good enough for the maritime pine resin of the Landes and so, since 1900 or thereabouts, technical French engineers at Bordeaux, energetically assisted by the chemical section of the Bordeaux University, have devoted much attention to the subject of the resin distillation. The result has been a score or more of patents, in all of which fire heat is eliminated and complete control of temperature is maintained by systems of steam-heating and steam injection. France has thus been enabled to do the best with its pine resin and produces rosin with a good reputation in the trade and a thoroughly sound, merchantable turpentine.

The lesson learned in France gradually penetrated to India. The primitive stills first used in the United Provinces and the Punjab were re-modeled and modified till today the United Provinces possesses a battery of stills and secondary apparatus which ingeniously overcomes the defects produced by excessive unregulated heat, while the Punjab, boldly scrapping its obsolete plant, has erected a modern French one, modified to suit Indian conditions, which is giving entire satisfaction by the excellence of its products and the economy of its working. The Punjab rosin has been recently pronounced in some respects superior to French rosin.

A short account of the actual distillation of pine-resin as carried out at the modern Government turpentine factory (managed by the Punjab Forest Department) Jallo, Northwestern Railway, Lahore District, may be of interest. The resin received from the forest is taken out of the air-tight receptacles, loaded into tip-wagons and conveyed along an elevated tramway to large melting and mixing vats. There the resin is melted and mixed, steam heat only being used, the melting being assisted by the addition of turpentine from a previous distillation. The specific gravity of the resin is thereby reduced, so that, when the melting and mixing is finished, a period of rest enables the water and dirt, etc., to sink by gravity to the bottom of the vat, the clean light resin floating on the top. Evaporation is prevented by the lids of the vats being fitted into water-joints. The next stage consists in drawing off the clean resin to a storage tank, whence a measured quantity is taken over, as required, into a steam elevator and thence into the still.

In the still, which is steam-jacketed and kept hot by steam under pressure, giving one command of a wide range of temperatures, the turpentine in the resin is driven off by injecting steam. The water and turpentine vapors first pass into a trap-still to prevent any resin or rosin accidentally driven over from going further, and then through a huge condenser in which they liquify and whence they flow into a mechanical separator, the turpentine being pumped to bulk storage, while the water runs to waste.

To insure standard qualities the turpentine is re-distilled in a subsidiary still, passed through lime water to remove any traces of resinous acids, and de-hydrated by filtration through anhydrous sodium sulphate. As, however, this last mentioned process is thought to be a possible source of contamination it has recently been replaced successfully by a period of rest in bulk storage tanks. Experiments are also in progress to dispense with redistillation by accurately fractionating the distillate in the primary distillation. The turpentine is put up for sale in five-gallon drums bearing distinctive stencil marks, bung-hole discs and labels, to prevent tampering by retail traders.

The hot rosin in the still is drawn off by means of a sluice valve into a wagon and transferred to the rosin shed, where it is filtered through a layer of cotton wool and then run into casks, bags or tins while still moderately hot and fluid. The rosin is graded according to American standard into pale, medium and dark shades. Gross weight, actual tare, etc., are carefully stencilled on the package before dispatch. The rosin has proved uniform in quality, very clear and free from dirt, a most important matter in paper and shellac manufacture.

THE NAVAL STORES INDUSTRY IN MEXICO

(By M. B. Katze, Mexico City.)

[The following articles give a comprehensive view of the Mexican situation as the source of future supplies of naval stores. Mr. M. B. Katze is the manager of "The Mexican Company, S. A.," 414 Mutual Life Building, Mexico, D. F., Mex. This company owns large areas of Mexican timberlands and has maintained its head office in the capital city for some years. The other writers are also conversant with conditions in Mexico and their united comments form a valuable contribution.]

The Turpentine Pines Are Found in the Districts Enclosed in Black Lines. Turpentine Pines Are Also Found in Considerable Areas in Nicaragua and Honduras, and the Naval Stores Industry Will Some Day Be a Flourishing Industry There.

MEXICO contains about 765,000 square miles and a population of about 15,000,000. It is divided into 27 states, 3 territories, and one Federal District, like the District of Columbia. It is not possible at this time to estimate accurately the exact acreage in this Republic of the pine timber available for turpentine purposes, but it is safe to say that there are fully 8,000,000 acres of such timber. In direct contrast to the yellow pine, or turpentine belt of the States, the Mexican naval stores district is situated at an altitude above sea level of from 5,000 to 8,000 feet, while in the United States, the turpentine pines are not found anywhere at an altitude exceeding 2,000 ft. above sea level, and very little above 1,500 ft. This has been fully covered in the reports of the Forestry Bureau, of the Department of Agriculture, especially in the publication entitled "Timber Pines of the Southern United States."

Full and rigid tests have been made of the Mexican pines, and they have stood every test, and can be relied on as first class turpentine producing timber.

A crop of 10,000 boxes will easily produce 35 barrels of turpentine per year, and rosin in proportion. The percentage of spirits of turpentine extracted from the crude gum averages from 20 to 23 per cent. The quality of the product is identical with the best produced by the stills in the United States.

It is conceded that the Mexican pines would produce 50 barrels of turpentine (virgin boxes) to the crop, but for the cool nights prevailing at the altitude where the timber is located. Crude turpentine will not flow from the pine when the thermometer falls below 60

degrees, and as almost very night in the Mexican turpentine districts the mercury falls below this figure, averaging about 54 degrees, and while the flow is ample and copious during the day, the pines do not run at night. Therefore, the average flow cannot be secured from the Mexican pines (the first year) that some producers in the United States secure, viz: 45 to 50 barrels to the crop.

It must be taken into consideration that the average for three years in the United States will not exceed 100 barrels. The Mexican pines will produce as much the second and third years as during the first year, so that the production of a crop of boxes in Mexico in three years will equal that of a crop on the best timber to be found in the United States.

One great feature of the Mexican pine belts is that cyclones and tornadoes are unknown. Owing to the high altitudes and the pure and dry air prevailing, there is an absence of insect life, such as the black beetle, worms and bugs, which are so destructive in the Southern pine forests.

It is very rare that a "dry" or "dead face" is seen in a Mexican turpentine orchard.

The producing season in this country covers about 9 months of the year, beginning February 15th and ending about October 31st.

An operator in Mexico in turpentine extraction should cut his boxes or put up his cups during the months of November, December and January, and start his chipping operations not later than February 15th.

The rainy season in Mexico generally extends over a period of four months, namely: June, July, August and September; during the rainy season the work in the forest continues, as it rarely rains more than a few hours out of twenty-four, the greater rainfall occurring mostly at night. The weather is ideal and hardly a day lost, which brings up the average of extraction satisfactorily.

Regarding the Mexican laborers, they have been tested, and are developing into very desirable turpentine extractors, and give much more satisfactory results than the best negro laborers.

The supply of laborers is abundant and they are found to be peaceful, good-natured and conscientious in the performance of their duties. All that is required is the according of honest treatment and a little patience in teaching them the cutting of a regulation box and the putting on of a first class chipping streak.

The wages paid to the Mexican laborers at the turpentine stills varies from 50 to 75 cents, U. S. currency, per day.

It requires about three peons to chip over a crop weekly, in box cutting they average about 35 boxes per day, and are paid by the day and not by the box.

Dipping is done in five-gallon cans, and is paid for by the can at the rate

A Turpentine Pine in Mexico With Two Cups Attached.

of 15 cents per can, U. S. currency.

The Mexican laborers cannot be classed as fast dippers, their average being about ten cans per day, equal to 50 gallons, but as their wages for dipping is regulated by the can, the cost does not exceed that which is paid in the United States for the same work.

The stills at present operating on a small scale retain a supply of five-gallon cans, which are sent out to the stations in the forests, similar to our "barrel stands," the crude gum being brought to the station by dippers.

After filling each can, a number is attached to it, so as to identify same at the still, and give the credit due for the work performed.

The Mexican crude gum is brought out of the forests on burros, each burro carrying four cans. The cost of these burros averages about $10.00 American currency per animal. One driver can handle twenty to thirty animals, thus assuring the transportation of the product at all times, and in fact, it will be found much less costly than in the hauling of crude turpentine in the United States, where the cost of a pair of mules, wagon and harness will amount to about $800.00.

The average load of crude gum in the United States amounts to 150 gallons for a trip; eight Mexican burros will bring in as much crude in a day as a two-mule team.

In organizing the work to be performed by the Mexican laborer as refers to the extraction of turpentine it is best to have them in squads of from forty to fifty, with a supervisor in charge of each squad, as in this manner more effective work is assured.

In the operating of turpentine stills in Mexico, the laborer bears his own expense, and provides for his own shelter, thus avoiding the cost of construction of cabins. Most of the laborers have families who provide their food, and, therefore, it is unnecessary to establish a commissary in order to supply them with their necessities.

Credits are not extended, excepting for food supplied, which is deducted each pay day from their earnings, and therefore, no loss occurs through advances made them.

At the present time, but little turpentine timber is exploited within easy reach of the main lines of railroads, transportation being effective by "burros" and in some instances by wagons.

The duty from the United States for shipments of turpentine to Mexico, is 11 cents per kilo, gross weight; and on rosin, 6 cents per kilo, a kilo equaling 2 1-5 pounds.

In order that readers may secure a correct idea as to the exploitation of turpentine in Mexico, it is necessary to state that on account of this timber being found at an altitude of from 5,000 to 8,000 feet, said timber is located in the mountainous section of Mexico, as below this altitude commercial timber does not exist.

The average rainfall in these different timber regions, with the exception of Chihuahua, averages about thirty inches per annum. In most sections railroad connections to tap these different timber zones are limited, but, as regards the extraction of turpentine, this fact does not prevent the exploitation on a large commercial scale, for the reason that this is overcome by the transportation of this product by animals, as large pack trains of burros can be utilized for this purpose.

From expert American cruisers' examination, the pine timber of Mexico is found to be equal to that of Minnesota, Michigan and the Southern States. The illustration is taken from a tract of 500,000 acres of pine timber, located in the State of Guerrero, which the President of our Company, Mr. R. P. Jennings, recently negotiated for, giving an idea as to the stand of this timber.

Owing to practically all of the pine timber regions in Mexico being located on the Pacific coast side, it assures the operator the markets of the Orient, namely, Japan, China, India and also Australia. With cheap cost of transportation to all parts of the Atlantic coast, via the Panama Canal and the Isthmus of Tehuantepec Railroad from Salina Cruz on the Pacific coast side to the Port of Mexico, on the Atlantic side, assures the marketing of turpentine in all parts of the United States, as well as Europe.

The estimated cost for the transportation of turpentine and rosin from the timber forest to railroad or shipping port, should not exceed 50 cents per hundred pounds, as the average distance can be safely estimated at about thirty-five miles.

The turpentine is carried in cases of two five-gallon cans, and rosin, in boxes or bags of about one hundred pounds each; a burro can carry two cases of turpentine or two boxes of rosin at a trip, and can travel thirty-five miles per

Typical Turpentine Still in Mexico.

day, and will average about ten round trips per month.

The cost of feeding these animals is practically nil, as owing to an abundance of grass the feeding of these animals is unnecessary, as they take care of themselves in this respect.

In the pine timber regions of Mexico, an abundance of pure water is found, which affords a never-failing supply for man or beast.

The Mexican pines have a good feature, not usually met with in the States. The crude gum finds its way to the box and cup, very little adhering to the surface of the tree, so that very little scrape is found. This obviates a large amount of trouble and expense in the winding up of the season.

Another feature of advantage to the Mexican turpentine producer is the great abundance of water that exists in all these regions, there being no necessity for pumps. It is also possible at every still to so locate the plant as to "terrace" the resin vat and draw off the rosin by gravity, in place of having to dip it up.

The climate in the turpentine timber districts is all that could be desired, and never fails to excite the enthusiasm of Americans after visiting these sections, disease being virtually unknown.

The best turpentine timber is found in the States of Michoacan, Durango, Oaxaca and Guerrero. While it is true some good pines are found in some few other Mexican States, it is limited in quantity, and the best turpentine producing timber will be found to exist in the States above mentioned.

A very important feature connected with the pine timber districts of Mexico is that fires are almost unknown, this owing to the fact that on account of the rainfall, the grass is usually green, and furthermore, the natives never build large fires. There also being but very little inflammable matter under and around the trees, owing to the mountainous character of the ground, a fire will not spread with the rapidity as in the level woods of the States.

To sum up, Mexico presents the following advantages to the naval stores producer:

First: Cost of the timber being much cheaper than in the United States.

Second: Mexican labor being superior to that of the negro and much cheaper.

Third: Lack of danger from cyclones and tornadoes, same being unknown.

Fourth: Absence of injurious insects, such as bugs, beetles and worms.

Fifth: Low cost of transportation, and practically no expense for the feeding of animals.

Sixth: No danger from forest fires.

Seventh: No losses of money and goods advanced to laborers.

Eighth: Perfect health conditions.

When one considers the rapid decline of the turpentine production of the United States and the fact that the pine forests of Mexico are practically virgin, the importance of the future turpentine industry in Mexico should appeal to turpentine producers in the United States. We believe that now is the opportune time for investments, which is owing to the low prices that timber tracts can be purchased for, together with the low cost of taxes, which are far below those paid in the United States, as per example: On the tract being acquired by Mr. Jennings of 500,000 acres, the cost of taxes on said acreage will not exceed $2,500.00 per annum.

With an investigation of the timber forests of Mexico, covering a period of over fifteen years, and through the use of competent American cruisers, we feel fully qualified in submitting the above facts.

WOOD DISTILLATION IN DENMARK

THE announcement was made early in 1917 that a company had been organized at Copenhagen, Denmark, to extract turpentine and rosin from the roots and branches of fir trees. In reply to inquiries, the Chief of the Denmark State Bureau of Experimental Forestry made the following statement:

"Some three years ago a company was organized at Arnborg (near Herning), to extract turpentine, etc., from the roots and branches of fir trees, expectations of profitable operations being based on the high prices during the great war. But the company did not realize such expectations when the price for turpentine, etc., dropped before the factory was built. I am not aware of any other similar industries in Denmark. 'The Danish Heat Association,' and a factory for sulphuric acid, are making charcoal and tar from fir (pinus montana), and at different places charcoal is made from beech, spruce and alder in charcoal kilns."

TOO LITTLE WOOD OF FIR TREES TO OPERATE PLANTS IN SCOTLAND

In reply to the question as to whether it would not be possible to profitably operate distillation plants for the use of the wood of the Scotch firs, Mr. William T. Geddes, of Glasgow, wrote as follows:

"The Scottish Forestry Board some time ago went into the matter very fully, and exhaustive experiments were made. The conclusion was that the supply of cord (wood) was so limited, that a commercial proposition was out of the question."

MEXICO AS SEEN BY AN AMERICAN OPERATOR

(By R. G. Barrineau, Tepehuanes, Durango, Mexico, an Operator of Many Years' Experience in the United States.

Pine Forest in the Mexican Mountains in Which Naval Stores Are Worked.

THE time has come when the demand for naval stores and the rapidly diminishing supply of suitable trees in the United States is forcing turpentine operators to turn their attention to the timber resources of neighboring countries. Mexico has long been known to possess considerable areas of pine locked up in the rugged fastnesses of the Sierra Madres and the Indians have for many years marketed small quantities of low grade turpentine and rosin, but the quality of the timber, the climate, the mountainous country and many other conditions were so different from those encountered in the United States, that practical operators have found it very difficult to believe that satisfactory results could be obtained through the standard American methods.

Some scattering operations were begun by Americans during the latter years of the Diaz regime and an article written for The Naval Stores Review, in 1910, indicates that the experiments were quite successful, but the succeeding years of revolution put an end to the activity.

During the past two years, conditions in the State of Durango, one of the best timber States of Mexica, have so far improved that timber owners have renewed their work in a number of localities. And these improved conditions have received a great impetus from the overthrow of Carranza, whose policies and officials suffocated all business and enterprise. The new government brings into power some of the best and most intelligent elements in the country who have not only been surprisingly successful in conciliating the domestic dissatisfaction, but are working energetically to regain the confidence of foreigners and bring back that influx of capital so essential to this country, which has often been characterized as "the world's greatest storehouse of undeveloped resources."

At the beginning of the present year, The Brock-Hardie Land and Timber Company, whose nearest railroad station and postoffice is Tepehuanes, State of Durango, began an experimental operation on a 46,000 acre tract of pine, which is located in the north central

part of the State in the Candela range of mountains. Mr. R. G. Barrineau, formerly with the Bogalusa Turpentine Company, and well known in all the American turpentine States, has had charge of the work.

There have been identified on this tract of land seven species of workable trees: Western yellow pine (Pinus Ponderosa), limber pine (P. Flexilis), Mexican white pine (P. Strobiformia), Chihuahua pine (P. Chihuahua), Arizona pine (P. Arizonica), Mexican Pinon (P. Cembroides), and another kind not yet identified. These trees are all producing gum freely without notable difference in either quantity or quality except in the case of the Mexican white pine, which while producing a gum clear as honey and running very high in turpentine, exudes a much smaller quantity than the other species.

As with all Mexican timber, the trees are at an altitude of from 7,000 to 10,000 feet and in a rugged country. To a Louisiana or Florida operator, the steep mountain sides and deep canons look impracticable to work on, but the Mexican laborers climb up and down all day without much more apparent exertion than attends the work in the Gulf States.

The land is not surveyed into sections and townships like the American properties, but a column line was blazed north and south with a a compass, and crops and drifts run across following the slopes and valleys to make the work easier for the chippers and dippers. Trails have to be made on the steep slopes to provide for the collection and distribution of the dip cans. Burros are used to haul in the supplies and out the gum from the town of Tepehuanes, where the still is located on the railroad siding, some fifteen miles distant from camp.

It has been found impracticable to transport the still to the timber on account of the necessity of building a wagon road. The burros operate in trains of from twelve to twenty-four, in charge of a man on horseback, each six burros in charge of a man on foot. The fifteen-mile trip is made in seven hours each way, but, allowing ample rest periods for the burros, two days are used in a round trip. Four modified oil cans holding a total of 20 gallons, are carried by each animal and each can has to be provided with a tight cover to keep the dip from spilling and blistering the burro.

The trails are usually mere rocky paths that wind back and forth along the sides of the mountains and often zigzag 500 to 1,000 feet up the side of a slope set at an angle of 60 to 70 degrees from the horizontal—too steep for a man to climb straight up. These look difficult, but the tough little burro carries his two hundred-pound load complacently and waxes fat on five pounds of corn and a handful of straw per day.

The labor at this camp consists of both Indians and Mexicans. It is fairly abundant and fairly tractable, but they have most of the characteristics of children and have to be treated as such. A small percentage are able to read and write, but their children, who have come into the world since the beginning of the supposedly beneficent revolutions, have had no opportunity to learn anything. The labor is fairly apt and good chippers can be made in one season, but much patience is needed in handling them. Most all have families with several children and live in "jacales," or pole shacks, uncomplainingly, but this company has built log houses with good shingle roofs and the luxury is much appreciated. The people sleep on a single blanket laid on the earth floor and the entire family possessions can usually be loaded upon one burro. From exposure and lack of clothing, they are prone to colds and pneumonia in the winter months. The chief articles of food are corn tortillas and beans, or frijolas. Almost the sole meat is venison, which is plentiful in these mountains. The commissary is a very simple matter, the stock consisting of corn, beans, coffee, lard, tobacco (the whole leaf, in bulk), wheat flour, brown sugar, rice and a few other items.

Tortillas, the native bread, are made by boiling corn with lime to loosen the shell, then washing in baskets at the river, or spring. Then the pulp is ground between two stones, patted out thin and flat in the hand and baked on a piece of iron over an open fire. These cakes will keep for weeks and an unmarried man will often stock up with a two weeks' supply.

The first work done in the timber on this tract was in February and the gum began flowing in good quantity at once, although during the following month, when there was a period of high, cold winds, the flow was very small. Since March, the results have been exceedingly gratifying. It has been stated by some investigators of Mexican timber that the trees will not produce during the rainy season from June to October, but the work on the Brock-Hardie property proves, on the contrary, that this is the most favorable season of the year. At the time this article is being prepared, the first week in August, we are in the middle of the rainy season and can show numbers of cups that have filled with one streak only. We have gotten a very good dipping on two streaks and from three to four barrels per thousand cups on three streaks.

It is claimed that the rainy season in some of the timber States farther South is a time of veritable floods, but here in Durango there is less rain than at the same season in Louisiana and, because of the high lands, there is absolutely no bogging and very little interference with any part of the work. The temperature sometimes gets as low as 45 degrees at night, this time of year, and rarely over 70 degrees during the day. From November to April, it frequently freezes at night and remains quite cold during the days, but there are prolonged warm spells and we are of the opinion that the gum will flow in sufficient quantity to give a couple of dippings during the winter season. Snow sometimes falls, but rarely remains long on the ground.

Clay cups, made by native potters near the property, are being used. Several shapes were tried out, but one similar to the Pringle type is giving best results.

The laborers are able to get along on from 75 cents to $1.00, U. S. currency, per day, and this enables them to live up to their accustomed standard. In teaching them the work, they are allowed to work several days for from 75 cents to $1.00, U. S. currency, and are then put at piece work. After three or four weeks, about fifty per cent. of them are able to put up from 300 to 600 pairs of aprons or to chip 1,000 faces per day in a creditable manner. Dipping is paid for by the five-gallon can, at the rate of about a dollar a barrel.

The men are paid off every "quincena" or two weeks, and a feature is the complete explanation that has to be made to each man of the items of his account. After this lengthy conversation, they go away satisfied.

So far as we have gone, the results encourage the belief that considerable more spirits can be made here than in the average Louisiana or Florida timber and the average costs will not aggregate more than 60 per cent. to 70 per cent. of the cost in Louisiana. And in this connection one should not lose sight of the additional advantage gained from the exceedingly cheap timber which rarely runs higher in cost than $1.00 per thousand feet in this State, and properties distant from the railroad can be bought on a basis of less than 50 cents per thousand feet.

The trees in this section will continue to run to quite an extent for a month or more after being chipped, but weekly chipping and even once every four days will give the maximum results. Practically no dry faces are found and the trees have remarkable vitality. Young trees that have been cut down are seen to be sprouting again, and large trees lightning struck and splintered their whole length seldom die, so that it is safe to assume that the mortality caused by the turpentine operations is practically nil.

The bark on the majority of trees is very thick, necessitating the use of a hack with a throat one-half inch deeper than that used in the States. The sap wood is much thicker than in the American timber and this probably accounts for the relatively greater flow of gum from the Mexican timber. The wood is quite white, with an absence of dark, hard streaks, and as it is soft and light should be readily merchantable as white pine. The weight is from 25 to 30 pounds per cubic foot when thoroughly dry, the lighter weight coming from the old, slowly grown trees.

Some of the more enterprising of the native ranchers in the vicinity of Tepe-

Running Rosin Off Into Sacks at Mexican Still.

Mexican Peons Working Turpentine.

huanes are being encouraged to operate on their own account and sell their gum to the company's still. It is believed that considerable interest can be aroused in this way as it is seen that the business lends itself to Mexican conditions and requires very small capital. These operators will probably box their trees.

The people in general are very friendly to Americans and express themselves as very anxious to have them come here. Even when all troops and police protection was withdrawn during the recent revolution, there were no disorders of any kind and there have been no injuries to property or persons of Amricans in this State for a number of years past.

Taxes, although higher than ten years ago, are still very low, $600 per year being the sum paid into the government treasury by the company owning the 46,000 acres of La Candela.

The money here is all gold and in the larger denominations, both Mexican and United States, the latter passing at twice its face value. Change is very scarce and much business is conducted with "vales," or checks on local merchants. Pay rolls of foreign companies are handled in this way and these vales are accepted without question when drawn by reputable Americans.

THE TAR INDUSTRY IN FINLAND

(By Consul Leslie A. Davis, Helsingfors.)

[For additional information see illustrated article on pages 43-45 on this industry.]

THE tar industry in Finland is very old and was formerly of considerable importance, but the present production is comparatively small, amounting to about 50,000 hectoliters (40,000 barrels) per annum. Of this amount, about 30,000 barrels are produced in factories and the remainder, in kilns, or charring stacks.

The rosin industry, on the other hand, is quite new. The first rosin factory was built in Finland by the Finska Kemiska A. B. only 10 years ago. Stumps were used as raw material and treated by a special method invented by the founder of this factory. There are now three rosin factories in this country. Three of the paper mills also manufacture fluid rosin for the manufacture of soap.

There are about 40 turpentine distilleries in Finland. All of them are small, as the raw material can not be transported far. The Finnish distilleries can generally char from 3,000 to 4,000 cubic meters (cubic meter equals 1.307 cubic yards) annually. The largest is that owned by the A. B. Tjarindustri and is situated in Suolahti. About 9,000 cubic meters of stumps are charred there each year. Among the other larger distilleries are the factory in Keuru, E. Math. Bonn's factory in Kolho, and a distillery in Multia, recently built by theA. B. Rafso Angsag. The total annual production of turpentine is estimated at about 1,000,000 kilos (kilo equals 2.2 pounds), of which about 800,000 kilos are produced in dry distilleries, about 100,000 kilos in rosin factories, and about 100,000 kilos as a by-product in sulphate cellulose mills. About 40,000 cubic meters of charcoal are produced in the dry distilleries and somewhat more than that in the kilns.

The total value of the annual production of tar, rosin, and turpentine in Finland is at present about 18,000,000 to 20,000,000 marks ($450,000 to $500,000 at 40 marks to the dollar).

About 70 per cent. of the factories belong to Finland's Tjar-och Terpentinkontorslag, a union which was formed about 10 years ago for the sale of their products. It is probable that all the factories will soon join this union.

A TURPENTINE OPERATOR'S EXPERIENCE IN MEXICO IN 1910

(By Carey B. Townsend.)

[Mr. Carey B. Townsend, for many years representative of the Standard Oil Company, and later otherwise interested in naval stores, was located in Mexico some years ago. In 1910 he wrote several newspaper articles relatives to the turpentine industry, from which the following extracts are taken. Mr. Townsend, who died several years ago, was an enthusiast as to the possibilities of the industry in that country.]

WE will take up the great pine belt as a matter of principal interest, and I will state that there are twenty millions (20,000,000), acres of splendid pine, in all. Not over one or two million have, as yet, been exploited.

The striking feature of the Mexican pine belt to be noticed is that you do not find any pines, suitable for lumber or turpentine at a less altitude than 5,000 feet above sea level. At a lower altitude than 5,000 feet the pines are small, scrubby and scrawny, and no good for either the sawmill or the turpentine still.

Almost the entire pine belt of Mexico lies along the great Sierra Madre range, beginning in the State of Chihuahua, in Northern Mexico, and extending almost through to the Central American line.

The best pines are found between the altitude of 7,000 and 9,000 feet. We are operating two crops of boxes at least 10,250 feet above sea level. Ice forms up there nearly every night during the summer, but the trees run well and are first class turpentine producers. We have a mountain spring near the camp we established up on this high elevation, the waters of which are astonishingly cold, ranging from 40 to 50 degrees temperature, making it a natural ice water fountain. I sometimes ride up there—a distance of several miles from here—just to experience the sensation of drinking ice-cold water from an ordinary spring. It would be an ideal place for a man of means to build a bungalow, and establish a summer camp. The view from that spot is perfectly grand.

The best timber States of Mexico are as follows: Chihuahua, Durango, Michoacan, Jalisco, Guerrero, Oaxaco, Hidalgo, Puebla, Coahuila, San Luis Potosi, Nueva Leon and the territory of Tepic.

It looks like Providence located these grand forests of pine and oak up on the Sierras, out of the reach of the axe of the lumberman, while the horrible and inexcusable destruction of our magnificent timber belt in the United States was going on, until such time had arrived that people everywhere were awakened to the wickedness and wantonness of existing methods, and the necessity of calling a sharp halt on the wastefulness of the lumberman and the turpentine man.

Most of the Mexican pine forests, lying as I have said, along the Sierra Madre range, will in time be "turpentined," and then cut up for lumber, and the Pacific ports will handle the greater portion of the output. The United States Pacific trade and the Oriental markets will all get their supplies from the Mexican stills, in course of time, but it will not be felt by the Southern operators, as all of the United States product will ultimately be needed for the European trade and for the immense domestic market of the States. In my opinion, Mexico will not at any time compete for the European trade. When the Central American naval stores business is developed (which it certainly will, some day) then you can expect competition for your European markets.

A few words about the peon labor of Mexico, from the turpentine standpoint. I have been here long enough to speak authoritatively on this subject. I came to Mexico with a (natural) prejudice in favor of our negro labor, and with a good deal of skepticism about the availability of any other kind of hands for turpentine work.

And now I wish to say that I have found the Mexican peons can be easily and quickly trained to do just as good work in the woods as any of the best negro laborers in the South. We have been successful in getting as good boxes cut and as fine a "streak" put on our trees as you ever saw put on a Georgia or Florida pine. Most of the Mexicans are natural-born axemen, and they take to turpentine work like a duck takes to water. We have to "weed out" a certain per cent. of the men who cannot adapt themselves to the work, but the percentage is not large, say about 25 per cent., and those who remain are first-class hands. We start all newcomers in an "awkward squad," much as a drill sergeant does with a bunch of new recruits, and in a week or ten days transfer those who qualify to the regular gang and let the few who fail to do acceptable work go.

The Mexicans work best by contract, so we pay by the box, in boxing or box-cutting time, and then pay by the 1,000 in chipping season, also by the barrel in dipping. I had box-cutters who averaged seventy-five and eighty fine "gauge" boxes per day, and a few of our chippers take care of 7,000 and 8,000 per week. And I have two dippers who average four and five barrels each per day. Of course, the woods have to be ridden closely by experienced woodsmen, it being necessary for the overseer to learn the language, which is not difficult. The Mexican peons are naturally amiable and polite, and do not give us trouble except in rare instances. They are very sensitive, and we get the best results by treating them kindly and avoiding rough language in all our dealings.

TURPENTINING IN THE PHILIPPINE ISLANDS

(By Rafael Medina, Acting Director of Forestry, Bureau of Forestry, of Philippine Islands.)

A NUMBER of attempts have been made to determine the feasibility of securing naval stores in the Philippine Islands from Benguet pine (Pinus insularis), but none has resulted in anything definite. A company was organized in 1909, and after chipping a few trees it was disbanded and no further attention was paid to the trees.

Mr. Barber, school teacher, employed his summer vacation at Baguio in observing the flow of resin on ten boxed trees, but I doubt if he was there long enough to get results.

A beach comber once tried to get some money by making pine charcoal and tar out of pine logs in a log jam at the mouth of the Agno river gorge, Benguet Sub-Province. He secured some tar which was sold in Manila, but the venture was not a success, as it was not attended to properly.

Messrs. Brooks and Richmond of the Bureau of Science, have investigated the quality of the resin secured from Benguet pine. The former boxed 30 trees near Baguio during the dry season and after twenty-four hours obtained 4,400 grams of resin not counting that which was lost. The thirty trees included some which were fire-scarred or otherwise defective and of these three had stopped flowing. The others were flowing slowly. Mr. Brooks presumes that the production would have been greater during the wet season. Having collected enough resin for his purposes, he paid no further attention to the trees and there is no data as to what can be produced by regular chipping.

The results of the investigations have been published in the Philippine Journal of Science, Vol. 9, Section A (1909), pages 231 and 232, and Vol. 10, Section A (1910), pages 229 to 231. Mr. Brooks is convinced that resin from Pinus insularis is practically identical with that obtained in the United States.

The species known as Pinus merkusii also produces resin, and, in Spanish times, naval stores were obtained from this species near Santa Cruz, Zambales. The stand of trees in that region will hardly warrant operations at the present time.

There are a number of groves in Benguet which could be tapped for resin without interference from lumbering operations, but they are so remote as to make it unprofitable at the present time.

The Bureau of Forestry is arranging to investigate the production of resin but at present no data is available.

Bulletin 20 of this Bureau, entitled "Philippine Resins, Gums, Seed Oils, and Essential Oils," contains the following general information:

PINUS INSULARIS Endl.

Saleng or Benguet Pine.

Local names: Alal (Zambales); balibo, booboo, bulbul, ol-'ol, saung (Benguet); parua (Iloko); saleng (Bontoc, Lepanto, Abra, Nueva Ecija, Ilocos Norte and Sur).

Two species of pine are natives of the Philippines, one of which, Pinus insularis, was used in Spanish times as a commercial source of turpentine. Richmond says that the turpentine collected from this tree has an appearance and consistency somewhat like that of crystallized honey and possesses a pleasant odor; while Brooks, after an investigation, states that it is practically identical with that produced in America.

Brooks measured the flow from a number of trees. Concerning the results he writes:

"On March 13, fourteen trees situated in the forest adjoining the claim of the Headwaters Mining Company were boxed. The trees were selected at random and included several trees of the varity known to lumbermen and turpentine collectors as "scrub pine." Six hours later thirteen of the trees showed an abundant flow of resin, while one was hard and did not flow. The collected resin weighed 1,761.5 grams.

"On March 14, thirty trees were boxed in another locality about two miles distant from Baguio. They were selected with the idea of including both healthy and unhealthy looking trees and some which had been damaged by ground fires. On the following day these trees were again visited and all but three, which were hard and did not flow, were still running slowly. The collected resin weighed 4,400 grams.

"Method of Boxing: The boxes were cut about 30 to 40 centimeters wide, 12 to 18 centimeters deep, and 6 to 8 centimeters from front to back, varying with the size of the trees. They were made by inexperienced laborers, and were so badly split and bruised that much of the fresh resin was lost, hence the yields obtained do not accurately represent the total flow of the resin.

"One of the best flowing trees had a diameter of about 85 centimeters and produced 857 grams of resin in thirty-two hours, although a portion was lost by overflowing the box.

"These samples being taken during the dry season probably represent a smaller yield than would be obtained during the rainy season when the trees have more life and the loss by evaporation is less.

"The cup and gutter system of collection would also give large yields by minimizing the loss."

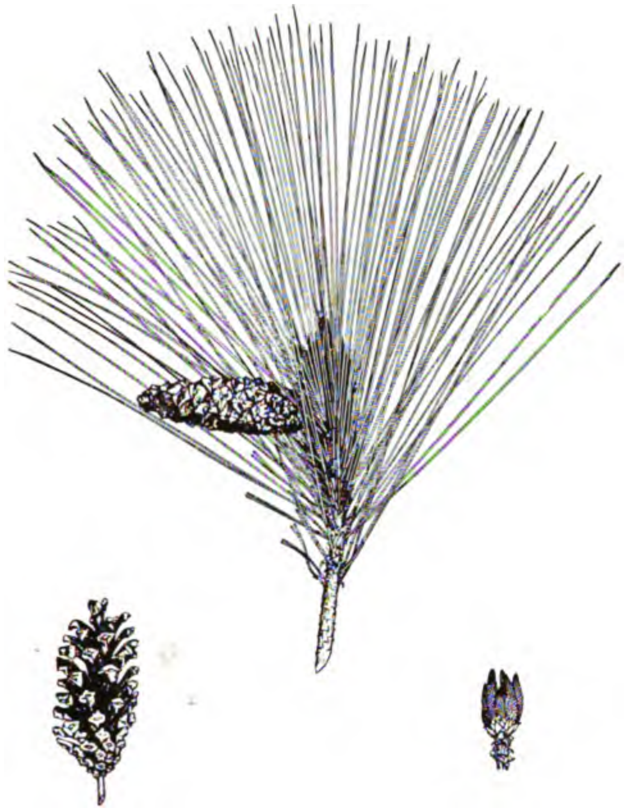
Richmond investigated the turpentine obtained from Pinus insularis and found that exhaustive distillation of the resin gave 412.2 grams (23.4 per cent) of oil of turpentine which was water-white in color.

Ninety-six per cent. distilled between 154° and 165.5°.

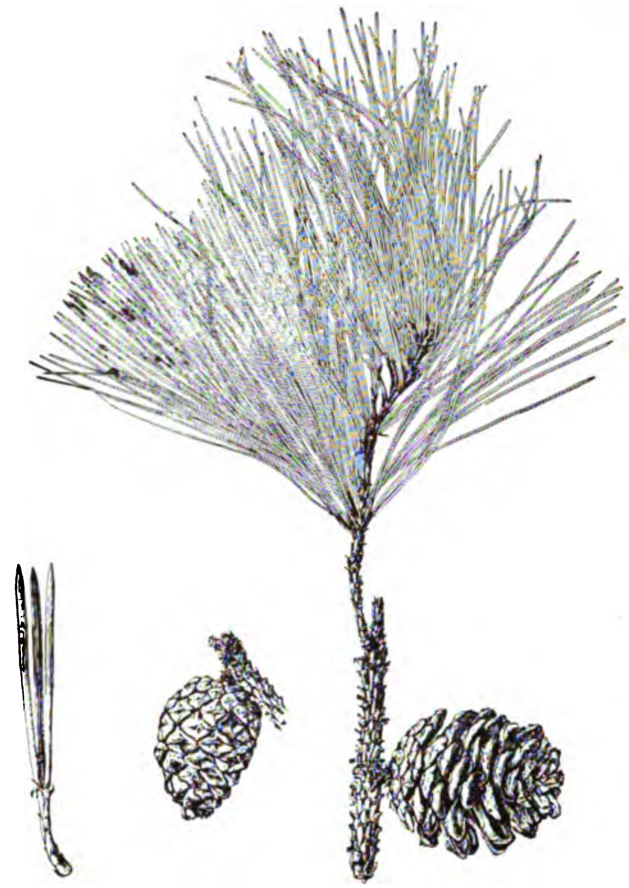
The residue from the steam distillation amounted to 76.6 per cent. of the original resin and was freed from approximately 15 grams of foreign material by hot filtration. It consisted of pine colophony of a clear, pale-amber color.

Brooks collected samples of the oleoresin from different trees and steam-distilled them, after which he determined the optical rotations. The values he obtained at 30° (13.15 to 27.48) were not very uniform, but the differences were not as large as those noted by Herty in the case of American turpentine.

The constants and chemical properties of the turpentine obtained from Pinus insularis indicate that the oil consists principally of pinene. Several derivatives of Pinene, such as pinene



Pinus Merkusii, or Mindoro Pine.



Pinus Insularis, or Benguet Pine.

nitrosyl chloride, were prepared from the turpentine. Brooks concluded that the turpentine and colophony from Pinus insularis are practically identical with those produced in America.

Pinus insularis reaches a height of 40 meters and a diameter of 140 centimeters. The bole is straight and clear, the crown narrow, with the lateral branches weakly developed. The bark is 10 to 25 millimeters in thickness, yellow or reddish brown in color, and broken in sections by vertical and horizontal cracks. The leaves are grouped in bunches of three, or sometimes two, and are 8 to 30 centimeters in length. The wood is moderately hard and heavy, resembling the yellow pine of the United States. The sapwood is white; the heartwood white and reddish brown with alternate light and dark rings, and very resinous. It is used locally for house construction, mining props, etc.

The species is found in the highlands of central and northern Luzon at altitudes varying from 500 to 2,500 meters, but is best developed at altitudes ranging from 900 to 1,500 meters. The stands vary in density from those composed of scattered individuals to nearly closed patches. The ground in a pine area is usually covered with grass. In the ravines, broad-leaved trees occur and there is considerable evidence to show that nearly the whole area now occupied by the pines was formerly covered with broad-leaved trees, the pines being confined to steeper and dryer situations, where the other trees did not flourish. Through the activities of man in past centuries, the broad-leaved trees have been cleared off, and repeated fires have prevented their reproduction. The result of successive fires is usually to leave the lands in possession of grasses. The pines are less susceptible to fire than are the broad-leaved trees and consequently the former occur over wide areas. If the fires were kept out, the pine, in the absence of competition with the broad-leaved trees, would quickly occupy the entire area, as its reproduction is abundant and rapid. The pines would then gradually be replaced by broad-leaved trees, as these will seed under the pines and cast such a dense shade as to prevent the growth of pine seedlings.

PINUS MERKUSII Jungh.

Tapulau or Mindoro Pine.

Local Names: Aguu (Mindoro); salit, tapulau (Zambales).

This species has not been investigated chemically, but its products are probably similar to those of Pinus insularis. The wood is apparently identical with the latter species, but seems on the average to be more resinous.

Pinus merkusii is a tree reaching a diameter of about 90 centimeters. The chief difference between this species and Pinus insularis is that the needles occur in groups of two rather than three.

This species is found in Zambales and northwestern Mindoro, occurring in the latter region in pure stands. In Zambales both Pinus merkusii and Pinus insularis are found at altitudes of only 100 or 200 meters.

NAVAL STORES PRODUCTION IN JAPAN AND CHINA

(By Thomas Gamble.)

IN a limited way Japan has been a producer of a poor quality of turpentine and rosins, made by small farmers. The industry has been merely a side line and the prospect of its expansion seems to have been meagre. Nine years ago the Deputy Director of the Imperial Commercial Museum, at Tokio, reported that the production cut but a minor figure in the industrial life of the nation, its consuming industries depending on the importations from the United States. In the intervening years the fact that the industry in the United States was declining and prices tending to permanently higher levels directed the attention of the forceful leaders of Japanese development to the likelihood of that country utilizing some of its waste lands, suitable for forestation, for the cultivation of pine trees that could be tapped for gum from which these commodities could be made. Interest in this proposition was accentuated by the rapid strides some consuming industries were making in Japan, paper making, for instance, having greatly expanded, the output of the mills represented in the Paper Manufacturers' Association having increased from 25,000,000 pounds in 1912 to 45,000,000 pounds in 1919, while soap manufacturers were similarly broadening their operations. Mr. Y. Fukukita, purchasing manager of the Oji Paper Manufacturing Company of Tokio, writing to me of the rosin requirements of Japan, said:

"Manufacturers of paper and soap are the principal consumers. The greater part of the rosin imports come from the United States, and the negligible contribution by China is of inferior quality. The average annual consumption in this country is now (1920) 40,000 barrels, of which approximately 70 per cent. is used by paper mills, the balance being distributed among manufacturers of soap, paint, etc. What is left from imports is usually re-shipped to Far Eastern countries and elsewhere.

"Rosin coming from China is manufactured in the southern part of that country. As might be expected, the industry there is in a highly primitive state, and the products are of inferior quality, being full of impurities. It is given scant consideration in its relation to the Japanese consuming industries."

The importations of rosins into Japan increased greatly in recent years, the shipments of naval stores to that country from the United tSates having been as follows:

Year Ending March 31.	Bbls. Spts. Turp. (50 Gals.)	Rosins. (Bbls., 500 lbs.)
1915	479	11,953
1916	1,992	33,639
1917	187	41,750
1918	1,180	48,684
1919	1,704	33,759
1920	670	102,749

(For statistics of exports to Japan years ending June 30, 1907-18, see pages 92 and 93.)

The financial upheaval and industrial depression that came upon Japan in the summer and fall of 1920 had an immediate effect on naval stores importations, which shrunk enormously after April. Very large stocks were on hand, considerable of which was offered back to dealers in the United States at a heavy loss to the Japanese holders. It is regarded as probable that the rosin purchases of Japan will fall back toward the old level for several years to come.

In December, 1919, Mr. Iwao Katayama, member of the Central Laboratory, and professor of the Keijo Technical College, of the Government General of Korea (Chosen), visited the naval stores belt of the United States for the purpose of investigating conditions affecting the growth of its long leaf pine trees, the soil, climate, etc., and the securing of seeds for use in testing the cultivation of such trees on selected spots in Japan. From the United States he went to France, and perhaps other naval stores producing countries, where different varieties of pines are used in the naval stores industry, with the object of obtaining similar information and arranging for seeds. On his return to Japan he wrote (November, 1920): "Though my country may succeed in introducing the naval stores industry (i. e., through forestation of suitable trees) the time for the successful consummation of such plans will be more than thirty years hence." Prof. Katayama also stated that serious inroads had been made on the pines of Japan on account of the high prices of timber during the war and it had really become a matter of anxiety as to the reforestation and what sort of pine to select.

Extending as Japan (including Korea) does, over fifteen hundred miles of latitude, with a variety of soils and climates, it is not unlikely that on some of the islands suitable areas of considerable magnitude may be found on which pines adapted to naval stores operations can be satisfactorily grown. While the industry could hardly hope to be one of great magnitude, as compared with that of the United States now or in former years, it is not inappropriate to recall that on a very small area France has demonstrated that 200 000 barrels (50 gallons) of turpentine and 500,000 barrels of rosin (500 lbs.) can be made annually with the industry on a permanent and very profitable basis. A persevering, determined, far-sighted and ambitious people like the Japanese, rapidly developing into a highly intensified industrial nation, are quite apt to emulate the example of the French in this respect and in coming years add the manufacture of naval stores to their other important sources of national growth and wealth. It is also not improbable, after some years, if the naval stores production of the United States diminishes to the extent anticipated, that under foreign tutelage the industry referred to in China may undergo material improvement. The cutting off of a great proportion of the vast production of rosins and turpentine heretofore marketed from the United States can have but one natural effect, the encouragement of the industry in all other countries possessing pine trees from which the oleoresin can be drawn.

SULPHATE PULP AND SULPHATE TURPENTINE

(By S. C. Lawrence.)

[Samuel C. Lawrence, born at Medford, Mass., Sept. 12, 1888, educated in the public schools of Medford, one year at Noble & Greenough's school in Boston, and one year at the Thacher school in California, before entering Harvard college in the fall of 1906. After graduating in 1910 he spent a year in the graduate school of Harvard specializing in chemistry and mining geology, and one year in the graduate school of business administration at the same institution; then went to Canton, N. C., where he was employed by the Champion Fibre Co. in its pulp and paper mill for about two years. From there he went to West Point, Va., to the Chesapeake Pulp & Paper Co. Inc., where he got his first experience and training in the manufacture of sulphate pulp. He spent about two years in this plant, working in all departments of the mill, leaving in December, 1916, to start the construction of a new mill at Savannah, Ga., for the Atlantic Paper & Pulp Corp. After construction was completed he spent the next two years as general superintendent, in active charge of operations, and is at present holding the position of mill manager.]

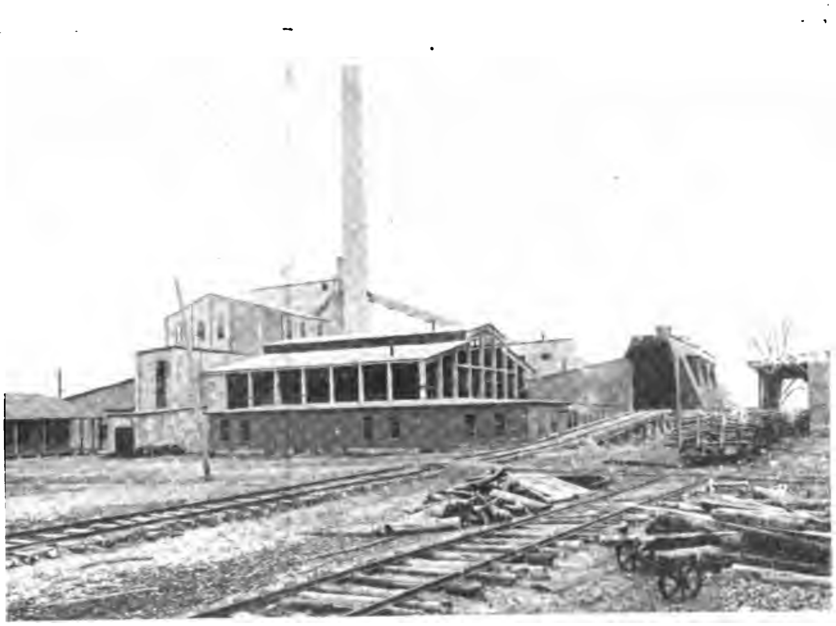
FOR many years there has been an enormous amount of unavoidable waste in the lumber industry, but conservation of our forest resources will in time demand the utilization of this present loss. The economic value of the slab wood which is now being recklessly wasted in the ever-burning refuse pits of our saw mills, is almost incomprehensible, and will cause the next generation to look down with a pity akin to horror on the intelligence of the present day which allows such a state of affairs to exist, for this saw mill refuse can be used to excellent advantage as the chief raw material of the paper industry.

The wood used in our plant is either long or short leaf pine, and arrives at the mill in four-foot lengths, running from two to fourteen inches in diameter. The greater part of this wood is shipped in by rail, but a considerable portion of it is brought in on lighters. We also use saw mill slabs and edgings obtained from neighboring plants, but cannot utilize burnt or rotten wood because it is detrimental to the finished product; the former on account of the fact that the carbon is unaffected in the cooking process and shows up as black specks in the finished sheet of paper, the latter because the fibre of the wood has lost its original strength and is either totally dissolved in the cooking process or appears as weakened fibre in the finished product and thereby detracts from the value of the pulp whose chief attribute is its strength.

After the arrival of the wood on our yard, it is barked either by hand with the aid of draw knives or sharpened hoes, or mechanically in a so-called barking drum where the wood is introduced into one end of a revolving cylinder and the tumbling action of the sticks against each other causes the bark to be removed by attrition.

The peeled slabs or wood are then loaded on cars and taken to the wood room where they are cut into chips about ⅝ inch long by machines known as chippers. These consist of a disc of steel about 7 feet in diameter, with four knives set in its face. The wood is introduced through a spout against the side of the disc and the knives proceed to cut slices ⅝ inch thick, off the end of each stick. These discs revolve at a speed of 250 to 600 r. p. m., making four cuts on the stick with each revolution, so that it takes only a matter of a few seconds to consume a four-foot stick of wood. The chips are then carried on belt conveyors to an inclined rotary screen, where the saw dust is screened out. This saw dust cannot be used for pulp as the fibres are too short, and consequently it is burned for fuel. The good chips, which are the correct length, then drop through the screen and are conveyed to the storage bin on top of the digester building. The coarse chips, which are too large to go through the meshes of the screen, are put through a crusher and then returned to the screen for another sorting, so that eventually everything is divided into either good chips or saw dust.

From the storage bin the chips are then run by gravity into the tops of the digesters, which are upright cylindrical steel tanks. When these are full of chips a liquor consisting of a solution of various sodium compounds is introduced. The cover is securely bolted on and the mass is cooked with steam introduced into the bottom of the digester. The pressure is raised to 105 lbs. and the cooking time varies from 1½ to 5 hours, depending on the kind of wood and the quality of pulp desired. Samples are taken from time to time to determine when the pulp is cooked to the desired point. The cooking liquor consists mostly of sodium hydroxide ($NaOH$), sodium sulphide (Na_2S) sodium carbonate (Na_2CO_3) and sodium sulphate (Na_2SO_4); the first two of which are the active cooking agents, and combine with the intercellular matter of the wood to form sol-



General View of Atlantic Paper & Pulp Corp. Sulphate Mill, near Savannah, Ga.

Diffuser Room, Showing Swivel Blow Pipes

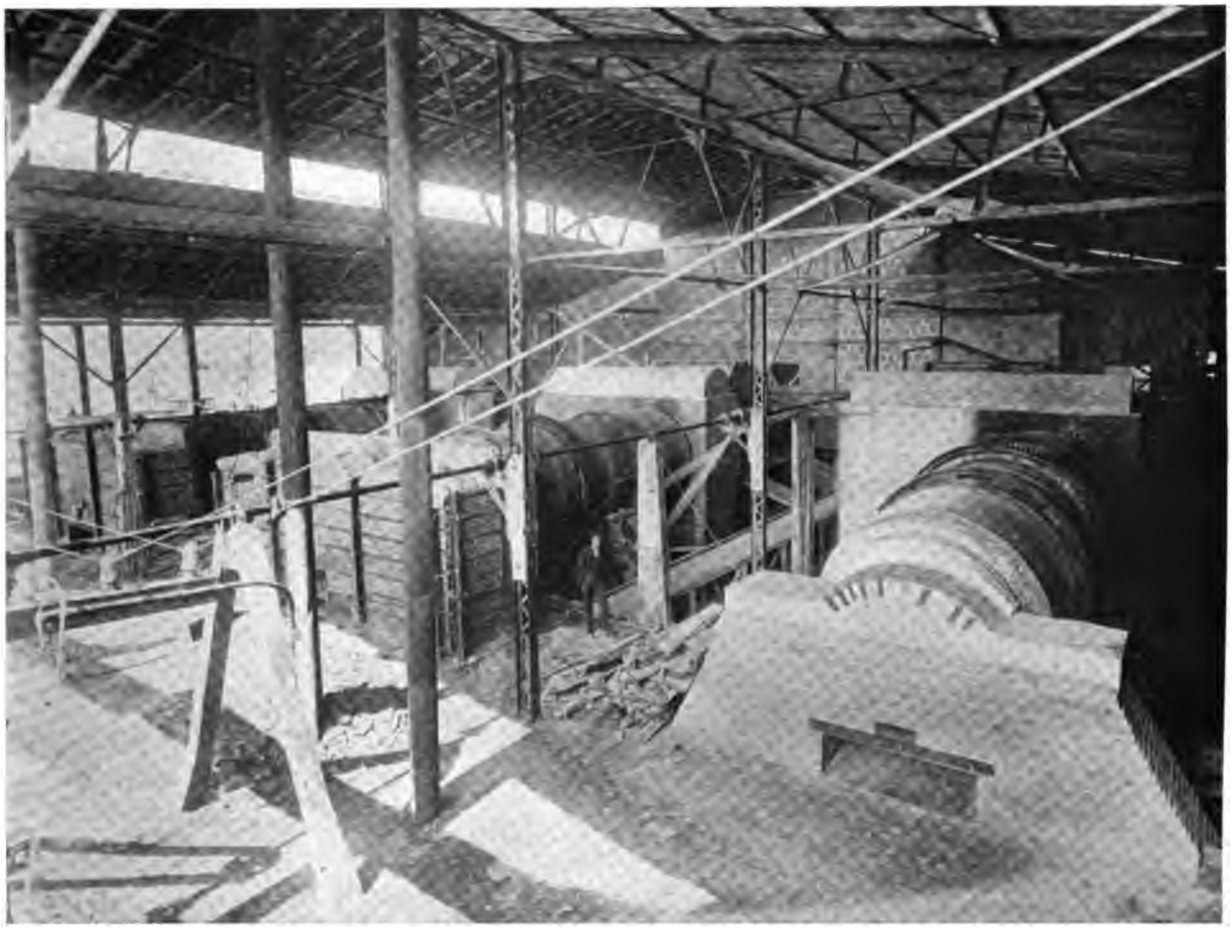
uble organic salts, leaving only the cellulose fibres. During the process of cooking, particularly during the early stages, there is an evolution of turpentine and other gases and these are released as the steam pressure is brought up and passed through coils of pipe submerged in water, which cause their condensation. They have a very strong odor, caused from the presence of organic sulphides, the chief of which is methyl mercaptan, but this can be removed by distillation with sulphuric acid in vacuo. The amount of turpentine depends, of course, to a great extent on the class of wood which is being cooked, but will run from one-half to two gallons to a cord of wood.

After the pulp has been sufficiently cooked, a valve at the bottom of the digester is opened and the whole contents of the vessel is blown through a pipe into the next room, into another closed cylindrical tank, known as a diffuser, where the pulp is separated from the waste cooking liquor by washing with water. The pulp is retained by the perforated iron bottom of the tank and the liquor and water pass through into a storage tank below.

When the pulp is thoroughly washed, a door in the bottom of the diffuser is opened and the whole contents of pulp and water falls into a storage chest below, from which it is pumped as required into the machine room.

Here it is screened and the knots and uncooked portions of the wood are removed. The cellulose fibres, very much diluted with water, are then piped to wet machines. This apparatus consists of a horizontal cylinder of fine mesh wire revolving in a vat. The fibres and water are introduced into the vat and the water is then drawn out from the center of the cylinder. This causes a current which carries the pulp fibres against the wire mesh and the water passing through, leaves a sheet of matted pulp fibres against the outside of the wire. As the cylinder revolves, this sheet of pulp gets thicker and when it reaches the top of the cylinder, it comes in contact with a woolen blanket, known as a felt, which has a greater attraction for the pulp than the wire has and which therefore transfers the sheet of fibre to itself. The sheet of pulp then passes over suction boxes, which extract some of the water, and then through press rolls between two more of these felts, which extract still more water. It finally comes out at the end of the machine about 47% dry weight of pulp and 53% of water. It is then folded by hand into bundles of ten or fifteen sheets for convenience in handling and loading into cars for shipment to paper or fibre board mills for use in manufacturing strong wrapping papers and container boards.

The waste cooking liquor, which is washed out of the pulp in the diffuser room, is carried to a quadruple effect vacuum evaporator, where it is evaporated from about eight degrees Beaume' to twenty degrees Beaume.' This multiple effect evaporator is of the "Yaryan" type, which consists of horizontal shells with tubes through which the liquor is forced, through small openings striking the tubes in a fine spray, while steam is acting on the outside of the tubes. In the first effect live steam



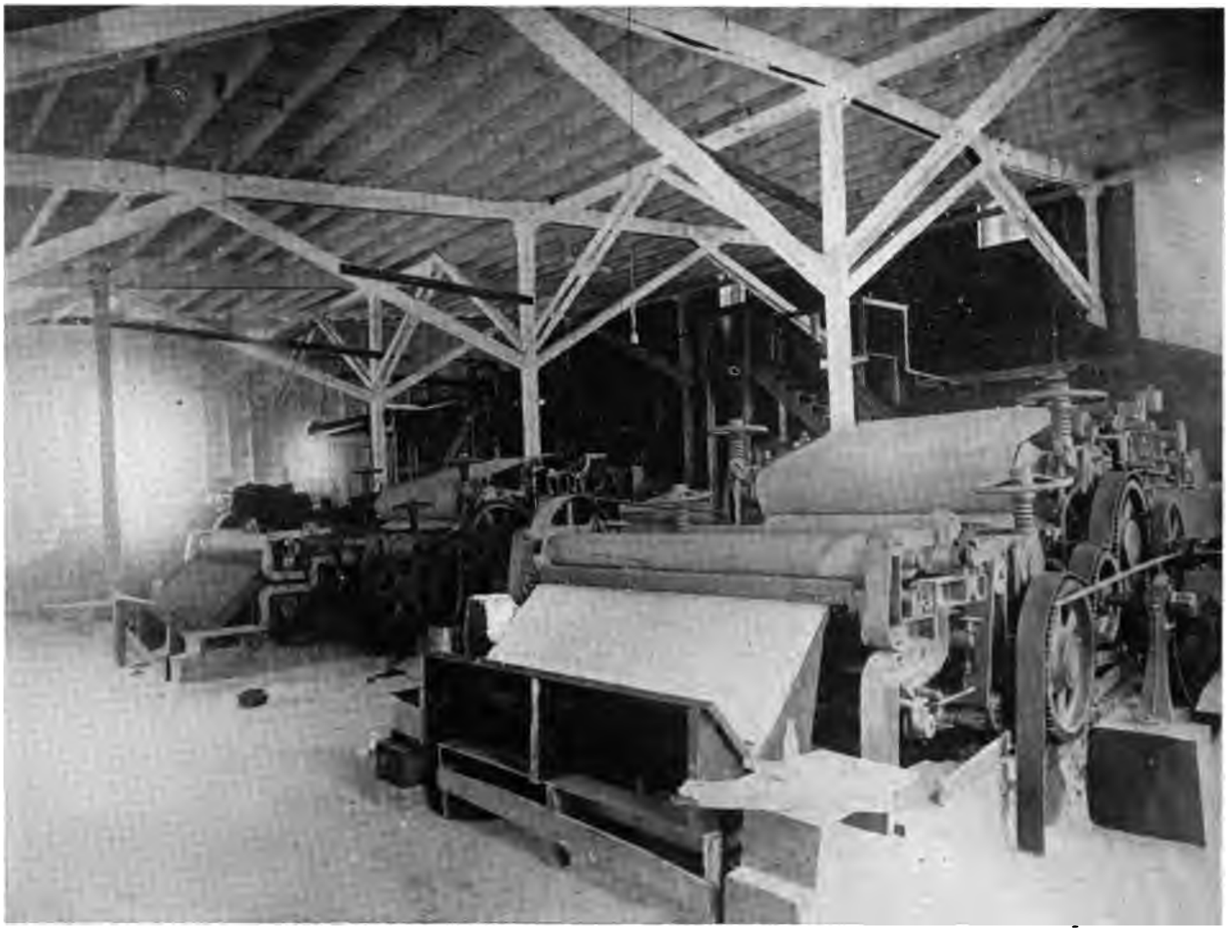
Recovery Room, Showing Flues from Melting Furnaces, Rotary Incinerators and Disc Evaporators in the Rear

is used as a heating agent, causing the liquor inside the tubes to boil. The vapor from the boiling of this liquor is introduced into the steam chamber of the second effect, causing the liquor there to boil, and so on to the last effect. This last unit is connected to a vacuum pump, which forms a high vacuum in this effect, with a gradually decreasing vacuum in the other units, except the first, which works under a slight pressure. The concentrated liquor from this last effect is drawn out by a steam pump, and pumped into a storage tank, from which it runs by gravity to a disc evaporator. This evaporator consists of thin sheet iron plates, mounted on a horizontal shaft and revolving within a closed tank. These plates are alternately half in and half out of the liquor, and evaporation takes place by means of hot gases from the furnaces passing between these plates as well as acting directly on the surface of the liquor.

From the disc evaporators the liquor which is now at a Beaume' of about 30 degrees, is introduced into a rotary incinerator. This is a horizontal steel shell, 30 feet in length and lined throughout with fire brick. The hot gases from the furnaces pass through this rotary which revolves twice a minute, the black liquor within being evaporated as it passes toward the front end of the rotary, where it finally rolls out on the platform as a moist black mass, known as black ash. This still retains a considerable amount of water and organic matter. From here the ash is shoveled through an opening in the top of the melt furnace, where its complete combustion is provided for by a forced draft from a pressure blower. At this point in the operation, a certain quantity of salt cake or neutral sodium sulphate (Na2 SO4) is mixed with the black ash as it is discharged from the rotary, the amount being regulated so as to exactly replace the soda lost during the process of manufacture. In these melting furnaces part of the sulphate of soda is reduced to sulphide of soda and the molten alkali, mostly in the form of sodium carbonate and sulphide with small amounts of hydrate and sulphate, runs from a spout in the front of the furnace into a dissolving tank, where it goes into solution.

The so-called "green" liquor from the dissolving tanks is allowed to build up to about 22 degrees Beaume' and is then pumped over to the causticizing department, where it is tested to determine the amount of lime necessary to causticize it. A high calcium lime is then added and the following equation takes place: Na2 CO3 plus CaO plus H2 O equals CaCO3 plus 2NaOH.

After adding lime, the mixture is boiled for half an hour and then pumped to settling tanks where the calcium carbonate settles to the bottom and the clear cooking liquor is syphoned off the top and pumped to the digester room. The residue of sludge is then washed with weak liquor and afterwards with successive washes of water until the soda has been completely washed out. The strong washings are used also as cooking liquor for the



Machine Room, Showing Wet Machines and Presses

digesters, while the weak washings are returned to the dissolving tank to be again built up to the required strength by the influx of molten alkali from the melting furnaces.

SULPHATE TURPENTINE.

The gases which are given off during the cooking process are found to contain ammonia, hydrogen sulphide, methyl mercaptan, methyl sulphide, methyl alcohol, acetone and turpentine. The turpentine as analyzed by Shuey & Co., shows the following characteristics:

Specific gravity at 15.5 degrees C., .8695.

Flash point, 39 degrees C.

Yield on distillation: Water, none; (a) Fraction from 155 to 165 degrees C. sp. gr. .8606, 74.00%; (b) Fraction from 165 to 195 degrees C., sp. gr., .8705, 18.50%; residue consisting of pine oil and tar, sp. gr. .9402, 7.50%; mineral oil absent. Total, 100.00%.

Result of distilling the above residue of pine oil and tar:

Distilling to a temperature of 244 degrees C., pine oil sp. gr. 925, 66.66%; residue, very light pine tar having sp. gr. approximately 97, 33.33%.

Fraction "A" and fraction "B", taken together, give a specific gravity of .8625, at 15.5 degrees C.

The residue from the distillation of the turpentine was very small to work on for the separation of pine oil and tar, and on account of the quantity being insufficient, the distillation stopped at 244 degrees C., but, on the other hand, had the distillation continued to any marked extent, the pine oil obtained would have had a higher specific gravity than the ordinary article of commerce, although other properties would have been similar. Ordinary pine oil runs from .9050 to .9255 in specific gravity, depending on grade.

Owing to the low specific gravity of the tar, it could likely be used as a crude tar oil, as an adulterant for tar oil; also its low specific gravity lends its use for making genuine tar oil by distilling to a coke.

A good grade of turpentine will yield on distillation 90.00% between 155 and 165 degrees C., and the government specification for flash point is 34 degrees C. It is calculated that fractions "A" and "B" taken together will yield on distillation 80% between 155 and 165 degrees, although very likely in actual practice the yield would be found greater than the theoretical owing to additional "cracking" of the product.

The somewhat foetid odor which the turpentine contains is due to the presence of organic sulphides, which can be removed by treatment with sulphuric acid containing 50% monohydrate, and subsequent distillation in a current of steam.

At the present time the recovery and the commercial utilization of the various by-products of turpentine and rosin are in the experimental stage, but we expect in the near future to make practical use of them.

PINE NEEDLE OILS

(By V. E. Grotlisch, Bureau of Chemistry, U. S. Department of Agriculture, Washington, D. C.)

[Mr. V. E. Grotlisch is a graduate of the University of Cincinnati and has been connected with the Bureau of Chemistry at Washington since 1914 in the capacity of assistant chemist. He has been engaged in the naval stores investigations for the past six years, has personally visited many of the turpentine stills in connection with the Bureau of Chemistry's campaign of education and demonstration of more efficient methods and processes for the production of naval stores, and has also engaged actively in the laboratory work on turpentine and rosins. The standard glass types for rosin are assembled and tested by Mr. Grotlisch and the compilation and publication of the Bureau's statistics on naval stores are under his direction.]

THE leaves or needles of practically all coniferous trees, such as the pines, firs, spruces, cedars and hemlocks, yield varying small percentages of oil when they are distilled with steam. These oils are frequently all classed under the term "pine needle oils," whether they are derived from trees of the true pine species or from other conifers. The oils obtained from the American red cedar or juniper tree (Juniperus Virginiana) and the white cedar or arbor vitae (Thuja occidentalis) are, however, known commercially as cedar leaf oils. The terms "hemlock oil" and "spruce oil" are interchangeably used for the oils obtained from American spruces and hemlocks.

The production of pine needle oils is an old established industry in Europe, particularly in Sweden, Austria, Germany, Hungary, Switzerland and Russia. It has been carried on in a rather sporadic way at various places in our Northern and Northeastern states, also in Pennsylvania, North Carolina, and the Pacific Northwest, but most of the domestic sources of such oils have been undependable. Some oil is also produced in Canada.

The method of production is practically the same everywhere. The young twigs, of less than one-half inch in diameter, and the needles are collected from the freshly felled trees, usually by women and children, and hauled in sacks to the centrally located distilling plant Here they are usually cut or chopped up into small pieces in a machine similar to the ordinary feed chopper, or occasionally crushed and macerated in pounding machines. This is to secure a maximum yield of oil, which is contained in oil ducts in the needles and twigs. The fine material is then placed in wooden or copper extraction chambers, having perforated bottoms, holding from 300 to 4,000 pounds of material. Live steam direct from a boiler is passed up through the material, vaporizing the oil and carrying it along. After condensing in a water cooled copper coil, the oil and water are separated in a receiver, where the oil floats on the surface.

The pine needle oils consist largely of various terpene compounds, among which are pinene, limonene, sylvestrene, cadinene, phellandrene, and dipentene. A compound known as bornyl acetate, the acetic acid ester of the alcohol borneol, is also usually present. It is this ester which imparts the agreeable piney odor to the oils, those having the most pronounced odor containing up to 30 per cent of this substance. Turpentine, which also consists of terpenes, chiefly pinene, is often used to adulterate commercial oils. The detection of such adulteration is comparatively easy, since the percentage of pinene in pure pine needle oils is quite small.

Probably the most important pine needle oil of commerce is that produced in Hungary, Austrian Tyrol and in the Thuringian Mountains of Southern Germany from the mountain or dwarf pine (Pinus pumilio or montana). The oil is distilled from the freshly gathered needles and twigs during May and June, the yield of oil being from 0.4 to 0.6%. It is a colorless to faintly yellowish oil, having a pleasant aromatic odor and a pungent bitter taste. It contains only traces of pinene, and consists chiefly of limonene, phellandrene, sylvestrene, codinene, and from 4 to 7 per cent of bornyl acetate. It has a specific gravity of 0.860 to 0.875 at 15 degrees C. The absence of pinene makes its adulteration with turpentine rather easy to detect. This oil is officially recognized in both the British and United States Pharmacopoeias, where it is called "oil of pinus pumilio" or "oil of dwarf pine needles." The oil is used as a medicament in the treatment of rheumatism and similar ailments, usually with chloroform or other solvents in the form of a liniment; also as an inhalant, in proprietary medicines and by itself, where it is mixed with steaming hot water and the vapors inhaled for the treatment of catarrh, laryngitis, and bronchitis. It has a stimulating and disinfecting action.

An oil distilled in Sweden and to a less extent in Germany from the needles of the Norway pine or Scotch fir (Pinus sylvestris), collected in June, is also used for similar purposes. It is known as Swedish pine oil. This was formerly the most extensively used of the pine needle oils for medicinal purposes, but recently has been largely supplanted by the oil from the dwarf pine. Unscrupulous adulteration had much to do with this result. It is used also in baths for the treatment of rheumatism, and as a deodorant in hospitals and sickrooms. It is a thin clear, slightly greenish oil, with a specific gravity of 0.870 to 0.886, and possesses the peculiar sweet aroma of the Scotch fir. The yield of oil is about 0.5%.

The custom of scenting the air, not only in hospitals and sick rooms, but also generally in dwellings, seems to be much more extensively practiced in Europe than elsewhere. For this purpose an oil obtained from the silver fir, (Abies pectinata or alba), also known as the silver spruce or white fir, is used. The larger part of this oil is produced in the Alps Mountains of Switzerland, some also coming from Austria and the Black Forest of Germany. It is the most valuable of the pine needle oils, on account of its pronounced, delightfully fragrant odor. It is highly prized throughout Central Europe for produc-

ing the so-called "air purifiers," liquids, which when sprayed into the air in the house, give the entire place a peculiar fragrant, piney odor. This oil is also used for other perfumery purposes where the best pine odor is desired, such as in toilet soaps and bath preparations.

An oil known as templin oil is produced from the young green cones of this same tree. The new cones which come out in the spring are gathered and distilled during the fall and winter months. They are pounded with a wooden hammer until soft, and cooked in copper boilers with water. The yield is about 0.2 per cent. to 0.3 per cent. It is used externally in the treatment of rheumatism, in the same way as the Swedish pine oil. It consists largely of limonene and has a pleasant balsamic odor somewhat resembling lemon rinds.

Large quantities of pine needle oils are used for perfuming such commercial products as shoe polishes, furniture and for polish, axle grease, lacquers, turpentine substitutes, etc. For this purpose the oil need not have quite so sweet and fragrant an odor as the above mentioned oils, so long as it is agreeable and not unpleasant. Such an oil is produced in considerable quantities in Russia from the Siberian silver fir (Abies sibirica). The yield of oil is greater from this tree than from almost any other species and the total quantity consumed also surpasses all other varieties. Its specific gravity is about 0.910 to 0.920, and it contains up to 35 per cent. of bornyl acetate. The odor is very powerful, and at the same time pleasant and aromatic. Toilet soaps which are perfumed with it are said to have a refreshing effect.

The common or Norway spruce (Picea vulgaris) is also used in Germany and Austria for obtaining an oil used for perfuming polishes and greases. The odor is not quite so powerful as that of the Siberian oil and consequently is in less demand. The yield is only about 0.25 per cent.

Pine needle oils, also called "spruce oils," are produced in the United States and Canada in commercial quantities from the black spruce (Picea mariana), the white spruce (Picea canadensis), the hemlock spruce (Tsuga canadensis), and the balsam fir (Abies balsamea). These trees are used in enormous quantities in the manufacture of paper pulp. The oils have a pleasant odor, but not so decidedly fragrant as some of the more highly prized European oils, the oil from the balsam fir being the most fragrant. The yield of oil is from 0.3 to 0.6 per cent. The several varieties of spruces frequently grow together in the forests and the needles and twigs of all are collected together, so that the resulting commercial oil is usually a mixture of spruce and hemlock oils, or of the various kinds of spruce oils. Both the physical properties and chemical composition of the various spruce and hemlock oils are very nearly identical. They have high specific gravities, from 0.907 to 0.929, and contain from 25 per cent. to 50 per cent. of bornyl acetate. They are used for the same purposes as the oils from the Siberian fir and Norway spruce. It has been estimated that the annual consumption of spruce pine needle oils in this country is between 40,000 and 50,000 pounds. The price ranges about 50 cents per pound.

Some years ago the Forest Service, United States Department of Agriculture, conducted some investigations on the possibilities of utilizing, for the preparation of pine needle oils, various pines and firs growing in extended areas throughout the United States, with the idea of profitably using the waste from lumbering operations and thereby reducing the forest fire risks. Among the varieties investigated were the Southern longleaf yellow pine, Cuban or slash pine, Western yellow pine, sugar pine, digger pine, lodgepole pine, Douglas fir, red fir, white fir, and incense cedar. The Canadian red pine, the pinon pine, the Engelman spruce, and the Northern pitch pine, have also been investigated. The average yield of oil from some of these various species (leaves and twigs distilled together) was as follows:

	Per cent.
Southern yellow pine (Pinus palustris)	0.401
Cuban or slash pine (Pinus heterophylla)	0.271
Western yellow pine (Pinus ponderosa)	0.112
Sugar pine (Pinus Lambertiana)	0.084
Digger pine (Pinus sabiniana)	0.088
Lodgepole pine (Pinus contorta)	0.234
Douglas fir (Pseudotsuga taxifolia)	0.163
Red fir (Abies magnifica)	0.140
White fir (Abies concolor)	0.128
Red pine (Pinus resinosa)	0.001
Pitch pine (Pinus rigida)..less than	0.001

Reference has been made to a yield of oil from fresh needles taken from trees of the Western yellow pine species growing in Oregon as high as 0.5 per cent.

It will be seen that with this exception, only the longleaf yellow pine gave a yield of oil which compared favorably with the yields obtained from the European and American species discussed above. The oil was obtained from fresh needles and twigs gathered and distilled in the month of June.

It was found, however, that, in general, the odor of the oils from western and southern trees was not as fragrant and pleasant as the odor of the oils of the Northern spruces. The oil from the lodgepole pine has been reported as having a pleasant odor. On chemical investigation the oils were found to be deficient or lacking in the ester, bornyl acetate, to which the pleasant fragrant odor of the highly prized oils is due. The long cold winters of our northern states, as well as in the sections of Europe from which the delightful smelling oils are obtained, would appear to have some relation to the odor of the oils. It has been found that the composition of the oil obtained from Scotch fir varied considerably, depending on the season when the needles were gathered and distilled. It may be possible then that oils distilled from longleaf yellow pine needles may prove to be of different composition and better odor at other seasons, possibly earlier in the spring. If dependable sources of pine needle oils were established in the South and the oil thoroughly introduced on the market, commercial uses of it would probably be found. Greater opportunity of better financial returns in other lines of work, however, would have considerable influence on the continuation of such undertakings.

In 1901 a plant producing pine needle oil from needles of the Western yellow pine was in operation in Oregon. The oil, which had a pleasant odor, was distilled on quite a large scale, being recovered from needles only, which were stripped from the twigs by hand. It was used for both medicinal and perfumery purposes. It is understood that this plant was discontinued some years ago for financial reasons.

The maritime pine (Pinus maritima) of France, the source of French turpentine, and the Aleppo pine (Pinus halepensis), the source of Greek turpentine, give needle oils which are quite similar to that obtained from the dwarf pine. They have a pleasant odor and are produced in small quantities for local consumption.

Pine needles consist of bundles of tough thread like fibres, together with resinous matter and the tubes or ducts containing the oil. A product known as fir wool is obtained in Germany from the needles of the Scotch fir. Instead of cutting the needles into short lengths, preliminary to the extraction of the oil, they are crushed by pounding. After the oil has been extracted, the needles are boiled for some time in water. This removes some of the resinous matter, the needles after drying still retaining a mild pine odor which persists for a long time. This material is used by hotels and rooming houses for stuffing pillows. It is also worked up into various articles of clothing, such as jackets, shirts, drawers, stockings and quilts, used by rheumatic sufferers.

If the extracted needles are boiled in a strong soda solution, all the oil and resin can be removed. After washing and drying, the resulting fibers are strong and elastic, and can be carded, felted or woven. The yield of such fibers is approximately 13 per cent. of the original weight of the needles. This pine hair makes an excellent stuffing material for upholstery, and is also suitable for mixing with plaster to replace cow hair. The needles of the Southern yellow pine, due to their length, make an excellent hair for all such purposes. The production of pine needle oils, from our Southern pines, together with the manufacture of pine hair, may prove to be a financially profitable undertaking.

U. S. GOVERNMENT'S TURPENTINE EXPERIENCE IN THE FLORIDA NATIONAL FOREST

(Prepared by the Forest Service, U. S. Department of Agriculture.)

"TO turpentine or not to turpentine?" That was the question with which the Forest Service, like all other owners of longleaf pine stumpage, was confronted when it began the administration of the Florida National Forest in 1909. After a thorough survey of the situation, however, it was decided in favor of turpentining.

The Florida National Forest is in two divisions; the larger, and at present the more important division, is situated along Choctawhatchee Bay and Santa Rosa Sound in Santa Rosa, Okaloosa, and Walton Counties; the other division is on Lake George in Marion County, in the Peninsula. The chief stand of longleaf pine is located in the western division and here it was decided to put into effect some conservative system of turpentining which would add to the income of the Forest without damage to the stand of timber.

Captain I. F. Eldredge, the first supervisor in charge of the Forest, called to his assistance P. D. Edmunds, a practical turpentine operator of 30 years' experience, and together they worked out the system which has been used in the Forest for the last ten years. The plan adopted by the Government differs in no radical way from that in common use by turpentine operators; the same tools are used; practically any cup system is accepted and labor soon becomes accustomed to the changes. The main features of the Government system are:

1. Shallow chipping, streaks being ½ inch or under in depth.
2. Half-high chipping; not more than ½ inch is taken off of the top of the streak each week; not more than 16 inches of face is allowed in any season.
3. The size of the tree cupped and the number of cups per tree are regulated as follows:

a. No trees smaller than 10 inches in diameter breast height are cupped.

b. On trees from 10 inches to 15 inches, inclusive, 1 cup is hung.

c. On trees from 16 inches to 25 inches, inclusive, only 2 cups are allowed.

d. Not more than 3 cups may be placed on trees above 25 inches in diameter.

4. The bars between the faces are kept intact. The bars must be not less than 4 inches in width at the narrowest point.

Ten years' experience has demonstrated the practicability of this system as to the production of gum, as well as to the reduction to a minimum of damage to the timber. For the last ten years the cupping budget of the Florida Forest has provided for the cupping of 14 crops of timber each year. In 1910 the first crops put on the market at public sale brought from $50 to $60 per thousand cups for a 3-year lease. In 1919, the annual public sale of turpentine privilege averaged $225 per thousand cups for a 3-year lease. The appreciation in the value of Government leases in the Forest has been constant and steady throughout the last 10 years, indicating that the operator finds the system profitable.

Under the plan in use by the Government, each tree is operated for 14 years during a period of 15, including back cupping. The front faces are worked 7 years, the trees are then rested for a year, and then back cupped for 7 years more. The damage to the timber as a result of the 14 years' work is so light as to be negligible in the ordinary stands of pine. Studies made on turpentined areas in the Florida Forest indicate that the total loss, due to turpentining in 14 years' operation, will probably be less than 3 per cent more than the normal death rate in virgin timber. On similar adjoining lands, operated under the usual system of turpentining by private owners, the loss in 6 or 7 years' operation, which is the strict limit for length of working in that class of timber, will average over 25 per cent; sometimes 75 per cent on the very poor sandhill stands.

The production of gum in the average crop for 14 years' operation will, of course, greatly exceed that obtained for like timber in the 6 years of destructive operation usually followed on private lands. In fact, except for the first 2 years, the amount of gum produced under the Government system per crop exceeds that under the old system every year in the course of the operation.

While the method used in operating Government timber on the Florida Forest has proved satisfactory for old-growth stands, it was realized that some other system of turpentining would have to be adopted for the second growth timber. In order to get some light on this subject, Captain Eldredge and Ranger E. R. McKee in 1914 started a series of trial operations on a typical stand of pine in Garniers Bayou in the western division of the Forest. A 640-acre section was divided into 4 drifts of 160 acres each. On drift No. 1 the regular Government method of turpentining was used; on drift No. 2 a modification of the first method was installed. The chief difference was in the width of the faces. On drift No. 3 the French method of turpentining, as practiced in the Landes region of France, was started. On the fourth drift was installed a modified French system in which the chipping was done with the French tools and the faces were 8 to 10 inches wide instead of 3½ inches.

The work on these four drifts was carried on from year to year under contract with the Garniers Naval Stores Company, of which Dr. E .P. Rose of Valdosta, Georgia, was president. The work was carried on strictly in accordance with the directions and a careful account of the gum gathered per season from the various areas has been kept. A progress report covering the results of the last five years' work is in course of preparation and will be published shortly. The results to date indicate that the modified American system, such as is used by the Government for its timber on the Florida National Forest, is undoubtedly the most practicable and profitable method for the extraction of gum from mature stands of pine which can not be withheld indefinitely from the saw. On the other hand, the results of the work at Garniers Bayou indicate that the French system is entirely practicable for use on second-growth longleaf and slash pine and that the revenue which can be derived from the young timber through its use can be very much increased and prolonged over that of the American system.

The experiments at Garniers Bayou are being continued. It is planned to keep them going during a period of at least 15 years. Progress reports will be issued out from time to time and supplied to interested persons.

THE MARITIME PINE IN THE UNITED STATES

(By Capt. I. F. Eldredge, U. S. Forest Service)

IN the 1912 annual number of the Weekly Naval Stores Review the investigative work which had been done by the Forest Service in the introduction of maritime pine in Florida and South Carolina was briefly outlined. This work consisted in setting out in 1910 a small amount of nursery stock of maritime pine in northern Florida. Conditions at that time were not favorable, so that the experiment was not successful. In the spring of 1911, about 600 pounds of maritime pine seed were sown on the Florida National Forest. In 1912, 800 pounds additional were sown; one-half on the Ocala Division of the Forest in East Florida, and one-half on the Choctawhatchee Division in West Florida. Different methods of sowing were used, including sowing in seed spots, broadcasting on unprepared land in furrows spaced six feet apart, and broadcasting on plowed land. With the exception of the broadcasting on unprepared land, the seed was harrowed or raked in. In order to protect the seed from birds and rodents, it was coated with red lead, and in one case, with tar and kerosene. The seed was sown at the rate of 5 to 10 pounds per acre, according to the methods used.

In 1912, after the trees had only been planted one or two years, the tentative conclusion was reached that maritime pine would be eminently successful, and perhaps even replace longleaf pine as a source of naval stores in the southern United States.

An examination made in February, 1920, of the plantation on the Florida National Forest indicates that the conclusions reached in 1912 were premature. At the present time, with one exception, the maritime plantations may be considered a failure. Many of the plantations still show a sufficient number of seedlings per acre to be considered successful, but these seedlings are scrubby, unhealthy, and practically dormant as far as growth is concerned, and apparently will continue to die out rapidly. The exact cause for the failure is not yet determined with certainty. Apparently, it is due to soil dryness, caused by root competition with the scrub oak which grows abundantly on the planting sites. This is borne out by results secured at East Bay on the Choctawhatchee Division and on the Ocala Division. The most successful plantation at East Bay is on land which was plowed before the seed was sown. It is typically a slash pine site which has not come back to oak brush since sowing. The most successful plantation on the Ocala, judging by the size of the trees, is one which was started on land first cleared of oak brush and then plowed. On that area some trees have reached a height of eight feet, but now that the oak brush is again establishing itself aggressively, even these are dying out rapidly. In other words, the trees were established successfully, but have not been able to stand the root competition. Even on the favorable sites at East Bay both slash and longleaf pine are exceeding the maritime pine in rate of growth. It is another case where native tree species proved more successful than exotics.

The Forest Service will continue to make examinations of these plantations as long as any trees are left, but already they may be considered a failure if considered from a commercial point of view.

An examination of the plantation at Summerville, South Carolina, in the summer of 1916, showed a serious loss of, and injury to, the maritime pine, due probably to the same leaf blight which attacked the longleaf pine in the South that season. This loss amounted to 15 to 30 per cent. in the strip where the seed had been planted in spots and 60 to 70 per cent where the seed had been sown broadcast. During the three years' growth which these trees made prior to 1915, when they were attacked by the blight, they made a height growth in 1912 of 2½ inches; in 1913, 5¾ inches; and in 1914, 7½ inches.

Another plot of maritime pine on better and more moist soil in the same vicinity showed a loss of only one or two to twenty per cent in different strips. The majority of the pines on this plot were 18 to 24 inches in height, and occasional ones, as much as 30 to 34 inches in 1916.

While results of these experiments four years after their establishment indicate greater success than has been secured on the Florida Forest, the ultimate success of this plantation also seems highly doubtful as a commercial undertaking. It is interesting to note that in this case also the slash pine offers much greater promise of success than does the maritime pine.

PERCENTAGE OF RECEIPTS BY MONTHS

THE late Spencer P. Shotter, basing his figures on the carefully kept records of the ten previous years, in 1913 prepared the following statement of the percentage of production of spirits turpentine from month to month during the naval stores season, as shown by total receipts:

Month.	Per Cent. For Month.	For Season to End of Month.
April	4.83	4.83
May	9.17	14.00
June	11.58	25.58
July	11.59	37.17
August	10.82	47.99
September	8.92	56.91
October	8.71	65.62
November	10.36	75.98
December	10.64	86.62
January	6.89	93.51
February	3.84	97.35
March	2.65	100.00

After this statement of monthly percentages had been prepared the cup system came more and more into vogue until the greater part of the crop was made by the use of cups instead of the old boxes. This altered the percentages by months. Mr. Carl F. Speh, secretary of the Turpentine Operators Association, prepared the following statement showing the average receipts under the existing conditions of production for the period of 1913-1920. The average for the three ports is approximately the average for the crop. These percentages, as compared with Mr. Shotter's for the previous ten years, indicate that under the cup system the crop is produced more rapidly than under the former system.

Cumulative Percentage of Receipt by Months. Averages of 1913-20.

	Savannah			Jacksonville			Pensacola			All Ports
	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Gen. Avg.
April	4.9	6.8	3.7	5.9	9.6	3.6	4.2	8.8	1.6	4.7
May	16.7	20.6	11.3	17.5	24.2	11.7	16.0	24.3	9.7	16.7
June	31.9	38.2	25.7	30.8	40.5	25.9	30.6	41.7	21.8	31.1
July	47.2	56.9	39.2	44.3	55.4	37.5	44.8	58.1	34.4	45.4
August	59.3	65.9	50.4	55.4	64.0	48.8	56.8	65.4	51.4	57.2
Sept.	68.9	73.2	60.7	65.6	72.8	61.1	66.4	71.5	62.1	67.0
October	76.4	80.1	70.8	75.3	81.7	71.6	77.2	81.3	73.1	76.3
Nov.	85.4	87.6	81.4	83.4	89.0	81.4	84.9	89.5	79.8	84.6
Dec.	93.1	95.8	88.6	91.3	94.5	90.1	92.5	96.1	91.7	92.3
Jan.	96.3	97.9	94.5	95.6	96.9	94.0	96.5	98.2	93.1	96.1
Feb.	98.1	98.8	96.5	97.9	99.4	96.6	98.9	99.4	98.1	98.3
March	100.0	......	......	100.0	......	......	100.0	......	......	100.0

WEATHER IN THE NAVAL STORES BELT

AVERAGE TEMPERATURE, IN DEGREES F., IN THE TURPENTINE BELT OF THE UNITED STATES.

MONTH	Wilmington	Charleston	Savannah	Valdosta, Ga.	Jacksonville	Tampa	Pensacola	Mobile	New Orleans	Lufkin, Texas
January	46.0	49.0	51.8	52.0	55.0	60.3	52.8	49.8	54.2	51.8
February	48.0	52.0	53.2	53.5	57.7	61.7	55.0	53.2	56.8	53.8
March	54.0	57.0	59.6	61.4	62.9	67.0	60.8	59.1	63.7	61.4
April	60.0	64.0	65.8	67.2	68.4	70.7	66.8	66.0	68.7	66.7
May	69.0	72.0	73.6	75.5	75.1	76.5	73.7	73.6	75.2	73.7
June	76.0	78.0	79.1	80.6	80.2	80.1	79.5	79.1	80.7	81.2
July	79.0	81.0	81.5	81.8	82.4	81.3	80.6	80.5	82.3	83.8
August	78.0	80.0	80.8	81.3	81.7	81.5	80.9	79.7	83.9	83.8
September	73.0	76.0	76.4	78.3	78.4	79.9	78.2	76.5	79.0	78.7
October	63.0	67.0	67.7	68.2	70.3	74.3	69.8	67.1	70.7	67.8
November	54.0	58.0	58.8	59.0	62.3	66.9	60.3	57.5	61.7	59.1
December	47.0	51.0	52.0	52.1	55.9	61.1	54.0	51.5	55.3	51.6
Year	62.0	66.0	66.7	67.6	69.2	71.8	67.6	66.1	69.2	67.8

AVERAGE RAINFALL IN INCHES IN THE TURPENTINE BELT OF THE UNITED STATES.

MONTH.	Wilmington	Charleston	Savannah	Valdosta, Ga.	Jacksonville	Tampa	Pensacola	Mobile	New Orleans	Ben Weir, Texas
January	3.50	3.35	2.83	3.57	3.01	2.62	3.96	4.85	4.47	5.46
February	3.39	3.38	3.32	4.04	3.31	2.74	4.49	5.36	4.20	4.26
March	3.59	3.67	3.39	3.43	3.35	2.25	4.90	7.17	4.44	5.24
April	2.86	3.44	2.90	3.01	2.80	1.72	3.90	4.35	4.72	5.90
May	4.03	3.44	3.06	3.57	4.34	2.71	3.17	4.00	4.25	5.57
June	5.62	5.24	5.71	6.37	5.35	7.73	4.55	5.95	5.39	3.62
July	6.97	7.35	6.26	5.95	6.22	7.80	6.70	7.04	6.58	4.19
August	6.51	6.83	7.57	5.92	6.19	8.40	7.89	6.81	5.77	7.96
September	5.27	5.28	5.25	4.11	8.01	6.89	5.55	5.02	4.65	2.97
October	3.74	3.74	3.27	2.21	4.97	2.59	4.01	3.18	3.50	4.51
November	2.45	2.75	2.24	1.75	2.32	1.88	3.70	3.74	3.73	4.13
December	3.12	3.05	2.91	4.07	3.04	2.07	4.67	4.57	4.63	4.59
Year	51.05	51.52	48.71	48.00	52.91	49.40	57.49	62.04	56.33	58.40

NET RECEIPTS SPIRITS TURPENTINE AT THREE MAIN PORTS FOR 1920-21 AND SEVEN PREVIOUS SEASONS

Month.	Savannah.	Jacksonville.	Pensacola.	Totals.
April	2,307	4,112	1,225	7,644
May	7,303	11,260	4,204	22,767
June	11,389	13,976	7,040	32,405
July	15,460	15,809	7,138	38,407
August	13,086	14,524	6,137	33,747
Sept.	11,659	14,206	6,297	32,162
October	9,665	12,044	5,931	27,640
November	8,997	10,706	4,190	23,893
December	7,483	9,582	3,909	20,974
January	2,540	4,355	2,018	8,913
February	1,274	2,607	1,574	5,455
March	2,088	4,121	1,514	7,723
Totals.				
1920-21	*93,947	117,302	51,177	262,426
1919-20	59,155	89,748	35,973	184,876
1918-19	46,820	76,175	29,833	152,828
1917-18	87,139	132,870	56,404	276,413
1916-17	99,045	148,119	68,580	315,744
1915-16	98,005	110,853	64,820	273,678
1914-15	138,145	106,070	73,711	317,926
1913-14	202,019	113,145	***	315,164

***Not available.

*706 added to the May receipts to agree with count.

FOREIGN SHIPMENTS.

Season	Spts. Turps. Bbls. 50 Gals.	Rosins Bbls. 500 Lbs.
1920-21 (est'd)	173,000	520,000
1919-20	214,633	730,290
1918-19	83,330	501,838
1917-18	106,803	734,263
1916-17	199 224	945,609
1915-16	192,654	869,505
1914-15	236,247	820,138
1913-14	377,772	1,470,970
1912-13	423,267	1,417,205
1911-12	377,473	1,421,935
1910-11	286,939	1,263,495
1909-10	299,181	1,175,634
1908-09	327,528	1,284,284
1907-08	350,715	1,555,159
Average for past 7 years, 1914-21	172,300	731,600
Average for seven years preceding world war, 1907-14	349,000	1,370,000

The foreign shipments of naval stores the past seven years have been approximately but one-half of what they were for the seven previous years.

It is found that of the crops produced the foreign shipments were as follows:

	Turps.	Rosins.
Seven Seasons, 1914-21	34	44
Seven Seasons, 1907-14	52	61

ROSIN OILS: THEIR MANUFACTURE AND THEIR USES

(By Philip McG. Shuey.)

[Mr. Phillip McG. Shuey, born near Staunton, Augusta County, Virginia, in 1885, received early education at public and private schools in Charlottesville, Virginia. At fifteen went to Choctaw Nation, Oklahoma, where his work consisted mainly of ginning cotton and "cow punching." At sixteen returned East to enter the Virginia Polytechnic Institute at Blacksburg, Virginia, graduating in "Applied Chemistry" in June, 1905, supplementing the course with special study in chemistry during a part of the summer vacations, under the late Dr. John W. Mallet, at the University of Virginia. The following session was instructor in chemistry, and at the same time took up post graduate work at the Virginia Polytechnic Institute. Following this, 1906, was offered a position as chemist for the Savannah Guano Company, which was accepted and filled for a period of twelve years, with the exception of one year which was spent in the phosphate fields of Florida in the employment of the Mutual Mining Company. In the fall of 1918 Mr. Shuey helped to form two organizations, one known as Shuey & Company, Incorporated, Analytical and Consulting Chemists, of which he is president and manager, and the other, The Liberty Oil Company, manufacturers of rosin oils, pitch and pine products, of which he is vice-president.]

AMONG the first to study the products from the distillation of resins was the French chemist Fremy in 1835, who at the time truly prophesied that the products from rosin would become of great commercial importance.

At the beginning of the nineteenth century the products obtained by the dry or destructive distillation of rosin was causing great attention in Europe and factories of considerable size were erected, but the real beginning of the rosin oil industry dates from the time at which the great pine forests of America, Pinus Palustris and Pinus Australis, began to be utilized in the making of turpentine and rosin. The lower grade "B" rosin is usually employed in the distillation of rosin oil.

Rosin oils are now manufactured in a large number of ways, depending upon the class of oil desired and the uses to which they are to be put, but the principal grade, known as "first run kidney" oil, which is also the base for the manufacture of most of the other oils, and constituting perhaps seventy-five per cent. of the rosin oils used, is still made after the manner of Fremy's early experiments.

First run oil is manufactured by subjecting rosin or colophony to a process of dry or destructive distillation by the use of superheated steam or direct fire in a closed cylindrical retort consisting of a heavy cast-iron still incased in brick. The bottom of the still may be of either cast-iron or steel. The top is usually built of cast-iron and is bolted to the flanged cylinder. Passing through the top or "head" is an outlet to which is connected a copper coil resting in a vat of water kept in circulation so as to afford the cooling surface for condensing the oil vapors.

All rosin oil stills are of similar design, varying in a few minor details, but their size may be from sixteen to thirty-five barrels of rosin (500 lbs. gross).

The process of distillation usually requires about twelve hours ,but this varies depending upon the amount of heat applied as well as the size of the charge. During the process a number of interesting products are obtained: First, a small quantity of water, derived from the original rosin, passes over and is condensed; then, as the temperature rises to about 150 degrees C., a thin, straw-colored liquid, somewhat resembling turpentine, but having a rather pungent odor and specific gravity of from .93 to .94, is condensed. This is known as "rosin naphtha" or "rosin spirits" and constitutes only about one per cent. of the total charge. This is separated from the water by allowing to stand, when it forms a distinct layer on top. The water may then be drawn off by pulling a plug at the bottom of the receiver. Following the naphtha, an intermediate product, amounting to about six per cent. of the original charge, is obtained. This is a fairly thin oil of specific gravity about .98, containing some admixture of rosin spirits not separated; following is the main portion of the run, known as hydrated "first run" or "kidney" oil, which begins to distil at about 200 degrees C. and amounts to about seventy per cent. by weight of the charge. This is a heavy oil with a specific gravity of from 1.003 to 1.01, containing from forty-four to forty-eight per cent. "rosin" acid or abietic acid (molecular weight 346), the specific gravity and the amount of acid depending upon the manner in which distillation is conducted. The color of the oil ranges from first white to varying shades of brown at the last stages, but all kidney oil will show a brownish cast on standing.

The opaque appearance of kidney oil is due to an emulsion of only about one per cent. of water in the oil. This small amount of moisture is distilled along with it and not added. The two being of nearly the same specific gravity, separation of the oil from any water in the form of layers is not readily effected, but the moisture in kidney oil is eliminated when it is desired to do so by heating in an open kettle either with steam or direct fire.

Finally a dark oil of specific gravity of 1.00 is obtained, which represents about six per cent. by weight of the original rosin, which is known as "bloom" oil. As this first flows from the still it varies from amber, as the color of the first portion, to reddish yellow as the last. After cooling, it has a decided blue cast ("bloom"), a property that is hastened by exposure to the air, and on storing it will gradually darken until it reaches a dark blue, almost black, appearance. The temperature at which this stage of the distillation is conducted is about 360 degrees C.

The amount of "rosin acid" in "bloom" oil produced as above will be from fourteen to sixteen per cent., but this may be increased by running more "kidney" into the "bloom." As there is a gradual decrease in the percentage of acid, from the first stage of a distillation to the last, an oil containing almost any amount of acid may be obtained, depending upon when and how the "cut" or separation is made.

Soon after the "bloom" oil begins to distil, the fire is pulled, when the remaining heat will be sufficient to run out the rest of the oil. If the fire is not pulled ahead in this manner, the

pitch remaining in the bottom of the still might be converted into coke, which aside from being useless, except as fuel, is very difficult to clean out. Also there is danger at this point of cracking the cast-iron still bottom.

The morning after distillation the pitch is drawn out of the still through the pitch cock below into barrels, usually of two hundred pounds each when filled. This is known in commerce as "navy" or "ship" pitch, and the yield amounts to about three per cent.

In the United States the more volatile products that are not condensed are allowed to escape into the atmosphere, but in Europe these vapors are usually either recovered and used as illuminating gas, or else used as fuel.

The above is in the main a description of the process of distilling first run rosin oil as carried on in the United States, but the process may be varied somewhat in detail, but not in principle. In Europe more scientific methods are employed, yielding products of different physical and chemical properties. The rosin obtained natively in Europe is also somewhat different from the American product, tending to give an oil of different characteristics. Some of the American made oil would probably be entirely unsuited to European trade, and likewise some European oil would cause trouble with American users.

On leaving the still, the rosin oil is allowed to flow either by gravity through pipes which lead to pits below, from whence it is pumped as desired, or else it is pumped from a receiver close to the still. This may be into a storage tank, or into a kettle for further treatment, or it may be returned to a still for redistillation. The rosin naphtha, however, being so small in quantity, is usually separated by allowing to stand in a receiver for this distillate, when it will rise to the surface forming a distinct layer above the water, as above described.

The light oil which is distilled after the naphtha, and the "bloom" oil which is the last off, may or may not be separated from the main portion of the run, depending upon the kind of oil desired and the purpose for its use. If kidney oil is desired, it is imperative that these be separated, as the color and "setting" qualities to make grease would be greatly impaired. Then if kidney oil is desired from the run, it is pumped into a tank from which it is drawn off into barrels. If a light colored dehydrated first run oil is needed, it is pumped into a kettle where it is first heated in order to eliminate the moisture. If a light color is not essential, the "bloom" oil may be added to this also, with or without the light oil following the naphtha, depending upon the specific gravity required.

If a "second run" oil is required, the whole of the first run, with the exception of the naphtha, is returned to a still to be subjected to a second process of distillation, which is carried on in a similar manner as when making the "first run" from rosin. The result is a thinning down of the oil and a lowering of the specific gravity and acidity, and consequently there is less odor than is to be found in first run or kidney oil. Likewise, successive distillations of an oil may be conducted, resulting in a thinner product and one with lower specific gravity and acidity following each distillation, but in commerce nothing higher than "fourth run" oil is required. A small amount of water and naphtha, and a small deposit of pitch, is formed with each successive distillation. Likewise, "bloom" oil, or any portion of the run, may be subjected to further distillation, and when rosin naphtha alone is redistilled, or refined by the use of caustic soda, the result is a light straw colored product, having odor and properties much resembling oil of turpentine.

PURIFICATION OF ROSIN OIL: While by far the major portion of rosin oils manufactured in the United States are sold in their crude condition, it is necessary at times to subject them to processes of purification which are exceedingly expensive. Fortunately, the trade in the United States requires this in only a few instances. The object is to remove the oil of all traces of acid and "bloom" or fluorescense, resulting in a practically odorless oil. There are quite a number of methods of obtaining this end, but the ultimate result is the same with all, viz: oxidation of the impurities and saponifying the rosin acids, both of which are removed by subsequent treatment. Two methods for purification are here given:

THE KRAMER AND FLAMMER PURIFICATION METHOD: This process consists in treatment with concentrated caustic soda lye followed by passing a strong current of air for a long time through the heated oil. In this way very large quantities of oxygen are brought into contact with the oil at a high temperature exerting upon it an action similar to that produced by the nitric acid in the Herrburger process, converting a number of the impurities into tar-like bodies.

According to the patent specification the process is carried out as follows:

The yellow oil is placed in a vat which contains a steam coil opening freely into the oil. Here the oil is quickly brought to the boil by steam at about three atmospheres pressure. As soon as the boiling temperature is reached, six pounds of caustic soda lye of 36 degrees B. are run in for every 100 lbs. of oil, and the boiling is continued until a sample of the contents of the vat separates quickly into an oily and a watery layer on standing. This shows that the alkali has completely saponified the resin acids originally present. When this saponification is incomplete, a sample remains turbid and dark brown for a very long time.

The contents are now left to stand until the oil has formed a clear layer above the solution of rosin soap. The latter is then run off and replaced by water, the volume of which is equal to one-quarter of that of the oil. Boiling is then resumed and kept up till a sample separates quickly on cooling. The water is then run off and mixed with the soap solution previously withdrawn for further manipulation.

The oil is now transferred to a vat with a false bottom and a steam coil. Here the oil is heated as quickly as possible to 60 degrees or 80 degrees C., at the same time a blast of air is blown through it in a number of fine streams, by means of an injector. After the blowing has lasted for three hours, the temperature is raised to 100 degrees C., and the blast is increased. The resulting oxidation further raises the temperautre to 110 degrees or even 115 degrees C., the end of the process being indicated when the temperature ceases to rise.

This process gives an oil quite free from acid and fluorescence. The smell is, however, not entirely removed, although it becomes very slight.

The rosin-soap solution obtained as above described can be mixed with other soap in the course of manufacture, or can be used for making resinic acid.

THE W. KELBE PURIFICATION METHOD: This process differs from that of Kramer and Flammer in that no aeration of the oil follows the treatment with caustic soda lye; Kelbe uses 16 litres of caustic soda lye of specific gravity 1.115 for every 100 kilograms of raw oil and heats to a temperature of 120 degrees C. This quantity of lye cannot, however, be regarded as an invariable quantity. Some crude oils will need more, others less. The chief aim of the process, as is the case with all those in which caustic soda is used, is the saponification of the rosin acids in the crude oil, and as their amount varies, the amount of lye required will vary in proportion.

There are certain practical tests for ascertaining whether sufficient caustic soda lye has been used. If a sample is dark brown after long boiling and quickly separates into two layers on standing, a clear pale oil-layer above with a dark brown soap-solution below, exactly the right amount of lye has been used. If solid matter is seen floating in the brown soap-solution, too little water is present to dissolve all the soap. In this case, if some hot water is added the solid flakes will disappear.

According to Kelbe it is of special importance to keep the temperature strictly between certain limits. During the time subsequent to the half-hour's boiling of the oil with the lye, the temperature must not fall below 50 degrees, or rise above 65 degrees. Below 50 degrees the oil is thick, and is therefore unable to rise quickly enough above the soap solution. If the temperature exceeds 65 degrees the dark colored soap

solution imparts some of its coloring matter to the oil.

After repeated treatment with water the oil is put into large flat pans in which it is kept at a temperature of 60 degrees to 80 degrees C. for a few days. Water and volatile oils then escape from it by evaporation. At the same time the fluorescent bodies are wholly destroyed, and the major portion of the odorous bodies also disappear, leaving a pale yellow oil almost entirely destitute of smell. It is easy to see that the lengthy heating of the oil in shallow vessels evaporates some substances and oxidizes others just as the air blast does in the Kramer-Flammer process.

COMPOUND ROSIN OILS: A large number of so-called compound rosin oils and varnishes are now manufactured for special uses. These may be pure, consisting of simply mixing different pure rosin oils together, or a pure rosin oil with mineral oil. Rosin may or may not be dissolved in the resulting product. Whenever rosin is dissolved in an oil, the result is, in its broadest sense, a varnish, but the term varnish in its restricted meaning is a more quickly drying product, the drying quality being accelerated by the use of so-called "dryers", or of light volatile products; the use of which is rarely resorted to at a rosin oil plant.

Varying the proportions of rosin, rosin oil and mineral oil, gives rise to an almost endless variety of oils, and the manufacturer today must be in a position to supply any oil that is required by any branch of industry. Different users in the same industry may require different oils, depending upon their custom and the formulae governing their manufacture.

The compounding or mixing of oils is conducted in an open kettle after dehydrating any of the oils containing moisture, particularly if the compounding is to be with mineral oil, for the latter darkens very much more under heat than does rosin oil. Further, to heat an oil like mineral, already free of moisture, would be an unnecessary expenditure of time and fuel.

If rosin is to be used in the compounding, it may be either melted first, and the oil pumped in on top of it, and the heat continued, stirring at the same time until the mass is uniform; or it may be pumped into the kettle first, the necessary amount of rosin then added and the heat applied. Heating may be done either by a steam coil or direct fire. The grade of rosin used to dissolve in an oil may be "E" or better, depending upon the color required.

CHEMICAL CONSTITUENTS OF ROSIN OIL: The chemical composition of rosin oils is not fully understood; they consist mostly of hydro-carbons belonging to the family of terpenes, and also smaller quantities of ternary compounds of the nature of aldehydes.

Later researches by Renard and Berthelot bearing on the constitution of rosin oil led them to infer that it is a mixture of three hydro-carbons only.

According to Renard, the average composition of rosin oil is as follows:

Diterehenthyl, C10 H15—Boiling point 333-336 degrees C.—80 per cent.

Diterehenthylene, C10 H14—Boiling point 345-350 degrees C.—10 per cent.

Didecene, C20 H36—Boiling point 330-335 degrees C.—10 per cent.

However, rosin oils vary greatly in composition, containing larger or smaller quantities of rosin acids and other oxygenated substances, depending upon the care and manner in which the process of distillation is conducted. In general, the heavier the "body" or higher the viscosity of an oil, the greater will be its acid content. This is important, as the amount of acid in first run kidney oil determines its value in grease making, for on this saponification mainly depends.

GENERAL PROPERTIES OF ROSIN OILS: The general properties of rosin oils vary greatly, depending upon the mode of distillation and the manner in which they are manufactured. A good grade of first run oil is very viscous, about the consistency of thick molasses. Kidney oil being opaque and in color of varying shades of brown, while the dehydrated oil is transparent, varying in color from almost water white to various shades of brownish red to dark blue, depending upon the amount of "bloom" oil mixed with the oil, and the manner in which the heat is applied for dehydration, and also the portion of the "run" from which the oil is taken.

Practically all rosin oil contains some fluorescence or "bloom" unless refined.

The color of the more highly refined oil is usually yellow or orange yellow, and sometimes a pure red.

The odor of all rosin oils is pleasant, but this varies from the strong characteristic odor of first run to the almost odorless refined neutral oil. Neutral rosin oil does not resinify on exposure to air. On the other hand, a rosin oil containing rosin acid, as first run, will resinify and will dry when exposed in a thin layer, with peculiar ridges, resembling the appearance of alligator skin.

Rosin oil has the greatest power for penetrating paper of any known oil, a property to which it largely owes its extensive use in the manufacture of printing ink and electric cables. It is further a poor conductor of heat and electricity. The pure oil is readily soluble in ether, chloroform, acetone and glacial acetic acid. The heavier grades are soluble in hot alcohol, and they are polymerized by concentrated sulphuric acid.

USES OF ROSIN OIL: The uses of rosin oil are many and varied, and it would be practically impossible to explain all of the many ways in which it is employed in various arts of industry. Its use in many cases is clothed with much secrecy, probably because of its comparative cheapness and wide range of use, which lends itself as a valuable substitute, either wholly or partially, for many products.

Its great capacity for absorbing oxygen gives rise to its drying qualities, which lend itself to extensive use in the varnish trade. A large printing ink plant uses from one thousand to two thousand barrels a year in the manufacture of printing ink. It has been estimated that in the eastern territory alone fully twenty-five thousand barrels, or one million two hundred and fifty thousand gallons, are used each year for various purposes.

Every petroleum oil concern of prominence has its grease plant to furnish the lubricant for vehicles, which is produced by mixing milk of lime with kidney oil; the "setting" being caused by the formation of calcium rosinate or lime soap. Petroleum oil is added, but the latter has no "setting" quality.

Rosin oil finds extensive use in the reclaiming of rubber. Old rubber seems to be revivified and made new by the use of rosin oil in the process. Also in making belt-dressing, and for saturating the inner plys of a canvas belt to inclease pliability.

In founderies it finds use in making core compounds. Molten iron coming into contact with the core, produced by mixing rosin oil with sand, does not cause disintegration, and the shape of the casting is retained.

Paper-wrapped electric cables are soaked in rosin oil owing to its high penetrating power and low electric conductivity.

It is employed in the manufacture of paints used in painting linoleum, burlap, for outside work such as fences, etc., and for water-proofing concrete.

Certain rosin oil is used in making shoe polish, to keep it soft and prevent its drying and cracking.

Rosin spirits or naphtha is employed as a substitute for turpentine and as a disinfectant.

In medicine, some salves are made largely from rosin oil, and the sticky nature of all kinds of adhesive plasters is the result of a film of a compound made from rosin and rosin oil known as Burgundy pitch.

Brewer's pitch is a compound made from rosin and rosin oil and is used in breweries to produce a smooth lining inside of casks, whereby they are made more impermeable and much easier to clean.

By proper chemical treatment of rosin oil it can be converted into a liquid which can be used in the mixing of paints exactly like the drying oils.

In conclusion, it is readily seen what a great variety of uses there are for rosin oils, yet all are not known to the trade. Progress in the direction of finding new uses for such oils has made tremendous strides in recent years. With this growing demand, there has grown with it an ever increasing number and variety of oils. The result is that a successful plant, supplying countless grades, is necessarily operated along extremely technical lines.

LIGHTWOOD, CUT-OVER LANDS AND THE NAVAL STORES INDUSTRY

(By L. F. Hawley, in Charge Section of Derived Products, U. S. Forest Service, United States Department of Agriculture.)

[Dr. L. F. Hawley, in charge of Section of Derived Products, at the Forest Products Laboratory, U. S. Forest Service, Madison, Wisconsin, is one of the prominent figures in the forestry world of this country. He graduated at Cornell University, in 1903, and received the degree of Ph. D. in 1907. His life has been of ceaseless activity in his chosen profession, and his career has been marked by its valuable constructive work. Except for three years with Arthur D. Little, Inc., of Cambridge, Mass., he has been connected with the U. S. Forest Service Wood Distillation and Wood Chemistry Section. Among his contributions to scientific literature have been the following: Government Publications, Bulletin 105, on "Wood Turpentine"; Bulletin 109, on "Distillation of Resinous Wood by Saturated Steam"; Bulletin 129, "Yields from the Destructive Distillation of Certain Hardwoods." Among his contributions to technological journals have been: To Journal of Industrial and Engineering Chemistry, "Efficiency Studies in the Hardwood Distillation Industry"; "Discontinuance Extraction Process"; "Recovery of Waste Paraffined Paper"; "Numerical Relation Between Cells and Treatments in Extraction Processes"; "Tar Still Operation in Hardwood Distillation Plants." To the Chemical Age, "Chemistry and Wood," and to Chemical and Metallurgical Engineering, "Flotation Experiments on Hardwood Tar Oils." Dr. Hawley's work promises to bring him in closer connection with the naval stores industry with the development of the wood distillation industry, which will become the source of large supplies of turpentine and other products in the coming years.]

"LIGHTWOOD" is a local term commonly applied to a very resinous or "fat" piece of wood from the longleaf pine tree. The same material is sometimes called "fat wood" or "pine knots." It is oftentimes referred to by a sound which can best be represented by the word "light'ud." Pine knots are sometimes found in connection with other pine trees, but not to the same extent and richness. The name "lightwood" may be given to bits of resinous, dark-colored wood in lumber or on the face of a turpentined tree; but, in general, it applies to the residue of dead wood left on the ground or in stumps and stubs and containing a very large proportion of resinous material. The cut-over lands of longleaf pine, and particularly the old turpentine orchards, contain large quantities of this lightwood.

The fact that the average longleaf pine wood contains only about 5 per cent. of resin, while lightwood may contain from 15 to 40 per cent. and may be obtained in commercial quantities with 20 to 25 per cent., has made necessary an explanation of the formation of such large amounts of this material. One theory is that, after a longleaf pine tree falls to the ground, the total amount of resin in the wood not only increases but is concentrated in certain portions of the wood which resist decay and fire and form the residue known as lightwood. Another theory is that as decay proceeds the resin from the decaying portion is transported to the central portion of the trunk, which thus becomes the lightwood. It is more generally accepted, however, that there is no actual increase in the resin content of any portion of the tree after it dies, but that the lightwood is the residue of the original tree, which on account of its high resin content resists decay after the rest of the tree has disappeared.

This explanation can be very readily illustrated by so-called "pine-knots," which are irregularly cone-shaped pieces of resinous wood found throughout the southern forests. If the limbs of a recently cut longleaf pine treetop are sawed off close to the trunk, it will be found that many of them have a core of very dark-colored resinous wood. Close to the trunk this core of wood may be 4 or 5 inches in diameter, but if the limb is sawed off 18 inches from the trunk there may be no resinous core noticeable. At intermediate points the diameter of the resinous core is correspondingly intermediate between 0 and 5 inches. The pine knot already existed in the tree before cutting and no mysterious secretion or transportation of resin is necessary in order to explain its formation after cutting. It is believed that the same thing is true in the case of other formations of lightwood, and that the large pieces of resinous wood from the trunks of the tree and from the stumps already existed in the original live tree. The term "lightwood" is, therefore, applied in the rest of this paper to both loose lightwood and stump wood.

No attempt will be made to explain the formation of the lightwood in certain portions of the living tree. This will be left to the plant physiologist, who may be able to give a proper explanation. In general, the sapwood of the longleaf pine contains comparatively small proportions of resin, while the heartwood contains various larger proportions, depending upon its location in the tree. The sapwood may contain about 2 per cent. resin, the average heartwood 7 to 10 per cent., heartwood of the butt log 15 per cent., and the heartwood of the stump 25 per cent. A large increase in the average resin content of the wood is therefore immediately apparent on the decay of the sapwood which contains the smallest proportion of resin.

Lightwood has been used for fuel in the South for many years. Its name was probably obtained from the custom of using its resinous splinters for torches, since the name could certainly not have come from its being light in color or in weight. On account of its high resin content, it burns very readily and has a high fuel value. It has had a large use for domestic fuel and has also been used by the railroads and in power and steam plants. Until very recently the wood-burning locomotive with the queer-shaped stack was a common sight on many of the railroads in the pine belt. The lightwood within a few miles of the railroads and within convenient collecting distances of all the cities and small towns has therefore been used up. All lightwood which is able to resist decay is suitable for fuel purposes; but for use in wood distillation plants the fattest, heaviest wood is the best. A good quality of lightwood is fairly easy to select, and an experienced man can readily distinguish between the poorer and the better grades.

Lightwood was probably the source of the first naval stores industry in this country, since tar and pitch must have been produced from raw material of this kind. The production of charcoal and pine tar in sod kilns was also probably practiced before turpentine and rosin were obtained by chipping the live tree. For many years tar and pitch were the only products obtained from lightwood and it was not until comparatively recently that retort plants were introduced for deriving wood turpentine and light tar oils, as well as tar and charcoal. The pine-wood distillation industry has expanded very much in the last few years, and now not only the destructive distillation products just mentioned but also steam-distilled wood turpentine and pine oil and the so-called "wood rosin" are produced from lightwood and stump wood in large quantities. Very large amounts

Lightwood at a Distillation Plant.

of lightwood have been used by wood distillation plants, and around such of the industry centers as Fayetteville and Wilmington, N. C., Savannah and Brunswick, Ga., Jacksonville and Pensacola, Fla., Mobile Ala., and New Orleans, La., the lightwood has been cleared up for many miles.

The collection of loose lightwood alone is of no great assistance in clearing the land if the stumps are not also removed. With the growing scarcity of loose lightwood, several wood distillation plants began the removal and collection of stump wood. This has now been going on in several centers for some years. The stumps are, of course, much harder to collect; but the quality of the wood is better. Wood distillation plants will not attempt the collection of stumps which are not at least 10 years old. In this period they are said to "ripen" fully, but will retain their good quality for many years more.

Aside from the difficulty of removing the stumps from the ground, the wood has an irregular shape and is difficult to handle; but notwithstanding all of these difficulties stump wood is now being used in large quantities.

Different methods are in vogue for removing the stumps from the ground, but it is believed that most of them are removed by means of dynamite or blasting powder. It is said that, if the charge of dynamite is properly applied, the stump is not only removed from the ground but is also split into irregular sections, so that it can be more readily handled. Some of the large manufacturers of explosives have special experts in stump blasting who furnish information on the best methods of using explosives for this purpose. A few stumps are removed by mechanical pullers, and special machines have been designed for cutting the stump close to the ground or for boring the stump with a special knife shaped so as to reduce it to small chips, thus combining two operations originally practiced by the distillation plants; namely, removal of the stump from the ground and grinding it into chips for the extraction process.

In this connection it is interesting to call attention to methods which have been suggested for removing stumps from the ground by less expensive methods than blasting or pulling. These apply particularly to getting rid of the stumps without paying attention to their utilization afterward. It is sometimes difficult to see why a very inflammable material, such as a pine stump can not be readily removed by means of fire; but the difficulty is that the wood is in such large pieces and is so firm and compact that the fire can take effect only on the surface. The ease with which a piece of wood may be made to burn depends very largely on its size. A small splinter of lightwood is very inflammable, yet a large, smooth-surfaced piece of the same wood cannot be ignited by means of a match and even if ignited by other means can be readily extinguished. It has been suggested that pine stumps can be readily burned if two auger holes are bored through the center of the stump from top to ground line and from side to center at the ground line, so as to furnish a draft. The fire is then started in the hole near the bottom of the stump and is supposed to continue burning until only the shell of the stump remains. This suggested method has been modified to provide for a forced draft by means of which the fire can be caused to travel not only upward toward the top of the stump but downward toward the roots until they are consumed far below the surface of the ground. When the difficulty of burning a fat pine stump is explained, it is easy to see that the method suggested for burning less resinous stumps by saturating them with an inflammable material, such as kerosene, would not be readily workable. It has also been suggested that chemicals be injected into the stump, such as nitrates or chlorates, which would furnish the necessary oxygen for the combustion of the wood. As soon as it is attempted to compute the amount of nitrate necessary for this purpose, it can be seen that the cost of the chemical would make this method impracticable, even if it were possible to saturate the wood evenly with the chemical. Information is often requested on some chemical which will soften or rot the wood more rapidly than the ordinary forces of decay. Up to the present time nothing of this sort has been discovered and there does not seem to be any good chance for developing a material which will assist in the rapid decay or disintegration of pine stumps.

The removal of stumps from the ground for the purpose of using the wood in distillation plants is, of course, a long step toward clearing the land and putting it in shape for cultivation. Although large numbers of stumps have been removed by wood distillation plants, we do not know of a case where long-continued practical co-operation has been reported between the land owner and the stump puller. It is difficult to account for this, because it seems that the combination of these two processes would be of great value to both the distillation plant and the owner of the land. One reason for this peculiar state of affairs is that not all methods of removal of the stumps are satisfactory to the land owner who wishes to use the land for agricultural purposes. Large holes may be left in the land, or the roots of the stump may not be removed below the level of the ground. On the other hand, not all stumps are good for distillation; and the wood distillation plants propose to select only the best quality and to remove them in such a way as to obtain the largest amount of the best quality of wood without reference to the condition in which the land is left. There are still left large areas of cut-over lands which are not considered immediately suitable for agriculture even after the stumps are removed; and these lands

are available for the distillation plants to remove the stumps in the manner best fitted to their purpose. There are many cases, of course, where the man who is clearing his land for agricultural purposes finds a market with a nearby distillation plant for at least a part of the stump wood removed and thus decreases the cost of his clearing.

It is to be expected that the co-operation between the distillation plant and the land owner will become of greater value to both parties in the future and that closer co-operation and more efficient methods will result. The wood distillation plant is certain to become more and more important in connection with the clearing of large areas of cut-over pine lands suitable for agricultural purposes. We know, of course, the approximate area of the lands originally covered with longleaf pine, and that stumps once existed on the area which has been cut over. We have no figures, however, on the amount of land from which the lightwood or stumps have been removed, or the amount of such material still available.

Showing Condition of Cut-Over Timber Lands Twenty-five Miles South of Hattiesburg, Miss.

As has been shown, lightwood was closely connected with the beginnings of the naval stores industry in this country; and although the main products in this industry have changed from tar and pitch to turpentine and rosin, yet lightwood may be the raw material from which the last products of the naval stores industry in this country will be made. Large amounts of turpentine and rosin are now being manufactured from lightwood and stump wood, and this industry is rapidly increasing under the present high prices for these products. As we look into the future of the naval stores industry, the rapidly diminishing supply of longleaf pine trees for the production of turpentine and rosin indicates that a very rapid reduction in the output of this industry will take place in the next few years. It seems very likely that for a short time an increase in the production of turpentine and rosin from lightwood will partly replace the reduction in output of turpentine and rosin from the living tree; but the supply of stumps is no more inexhaustible than the supply of trees which originally grew on these stumps, and probably within 10 or 15 years after the last tree of the present stands of longleaf pine has been cut, the stump of that tree will be pulled and distilled for the production of wood turpentine and wood rosin. What will be the condition of the naval stores industry of this country when that time comes?

NET RECEIPTS ROSINS AT THREE MAIN PORTS FOR 1920-21 AND SEVEN PREVIOUS SEASONS

Month.	Savannah.	Jacksonville.	Pensacola.	Totals.
April	6,915	14,889	5,225	27,029
May	20,590	35,115	13,857	69,562
June	34,574	39,854	18,842	93,270
July	47,814	45,539	20,394	113,747
August	42,901	46,472	17,591	106,964
Sept.	36,661	40,996	18,934	96,591
October	31,718	33,709	16,285	81,712
November	33,960	32,537	16,380	82,877
December	29,473	33,955	13,310	76,738
January	12,716	16,838	6,776	36,330
February	5,556	13,321	7,058	25,935
March	5,642	7,596	5,205	18,443
Totals.				
1920-21	308,520	360,821	159,857	829,198
1919-20	199,775	329,127	142,339	671,241
1918-19	185,313	270,337	101,426	557,076
1917-18	310,283	457,236	194,899	962,418
1916-17	370,472	506,389	239,018	1,115,879
1915-16	389,302	441,278	236,536	1,067,116
1914-15	459,587	306,690	240,691	1,006,968
1913-14	652,794	353,688	***	1,006,482

***Not available.

HIGHEST AND LOWEST PRICES AT SAVANNAH FOR THE SEASON OF 1920-21 AND 1919-20, APRIL 1 TO MARCH 31.

Spirits Turpentine.

1920-21—
High (in April, 1920) $2.33
Low (in March, 1921) .45

1919-20—
High (in March, 1920) $2.30
Low (in April, 1919) .70

Rosins.

Grade	1920-21 H	1920-21 L	1919-20 H	1919-20 L
WW	$19.75	$4.25	$24.25	$13.10
WG	19.25	4.00	23.95	12.75
N	19.00	3.75	23.00	12.50
M	18.25	3.60	21.75	12.25
K	18.00	3.60	20.75	12.00
I	17.75	3.50	20.00	10.90
H	17.75	3.50	19.10	10.70
G	17.75	3.50	18.75	10.50
F	17.75	3.50	18.75	10.50
E	17.75	3.50	18.75	10.45
D	17.75	3.50	18.75	10.40
B	16.25	3.50	18.75	10.25

In 1919-20 the highest rosin prices were in August, the lowest in May. In 1920-21 the highest were in April, 1920, the lowest in March, 1921.

THE FUTURE OF THE NAVAL STORES INDUSTRY AND PINE FORESTS IN LOUISIANA

WITH LESSONS APPLICABLE TO OTHER NAVAL STORES STATES

(By R. D. Forbes, Supt. of Forestry, Louisiana Department of Conservation, New Orleans, Louisiana.)

[Mr. R. D. Forbes, Superintendent of Forestry, Louisiana Department of Conservation, New Orleans, La., has held his present position for three years. Graduating from Williams College, Massachusetts, in 1911, with the degree of B. A., Mr. Forbes spent two years at Yale Forest School, thereupon receiving his M. F. He then spent three years with the United States Forest Service in Arizona, New Mexico, and North Carolina, and at the time of his appointment in Louisiana had been for fifteen months Assistant Forester of New Jersey, his native state. The Louisiana position, which is in effect that of State Forester, had just been created, and Mr. Forbes, as its first incumbent, has had large latitude in planning the forestry work of his state, working under the general direction of the Commissioner of Conservation and the General Forestry Advisory Board. At the last session of the Louisiana Legislature the already comprehensive forestry laws were strengthened, and adequate financial backing given the forestry work. In addition to biennial reports on forestry, contained in the reports of the Louisiana Department of Conservation for 1916-17 and 1918-19, Mr. Forbes is the author of "Wood Fuel," a report of the New Jersey Department of Conservation and Development, and of "Forest and Grass Fires in Louisiana," Bulletin 6 of the Louisiana Department of Conservation. He has contributed frequently to the lumber trade journals and American Forestry, and for the Journal of Forestry has written articles entitled " AForest Policy for Louisiana," and "Generalization vs. Specialization in Forestry Education." He is a Senior Member of the Society of American Foresters, and a Hoo Hoo.]

THE United States Forest Service estimated (July, 1920) that Louisiana had sufficient standing longleaf and slash pine to yield 13,500 crops of naval stores. This is 64 per cent. of the entire estimated yield of naval stores from timber now standing in the South and available for cupping. In addition, the best figures we have available indicate that in Louisiana about 5,000,000 acres of longleaf pine lands have already been cut over, and that about 1,500,000 acres more will be cut over in 10 to 20 years. The former heavy longleaf stands of Louisiana will average perhaps 3½ cords of stumps per acre, from which in the neighborhood of 15 gallons of turpentine per cord may be extracted by destructive distillation. On this basis the stump lands of Louisiana alone will yield 341,250,000 gallons of spirits of turpentine, or once and a half the total yield of turpentine which the Forest Service estimates can be obtained from all the Southern pine timber now standing. Added to our 13,500 crops of standing timber these resources are staggering indeed, and a few years ago the average turpentine operator would have found justification in such figures for calling them "inexhaustible." Today, however, no intelligent man who deals with forest resources uses the word inexhaustible in speaking of his raw material. In one forest region after another the forest industries have thought that the standing timber upon which they depended would last indefinitely, only to find that within a comparatively brief period the forests had dwindled and disappeared. It does not greatly matter, therefore, whether the figures given above—frankly "swivel chair" estimates so far as the production of naval stores from stumps is concerned—are 50 per cent. high or 50 per cent. low. The world's demand for naval stores is going to continue or increase, and in Louisiana, as in every other state, there is but one solution to the problem of how the industry may be perpetuated. Present sources of American naval stores may last ten years, as indicated in the Forest Service report above mentioned, or augmented by the distillates from stumps they may last two or three times as long. In the end they are bound to be exhausted, and it is the business of the forester to grow more trees in order that this industry, and all of the vital forest industries, may continue to exist.

The writer is not familiar except in a general way, with the forest conditions of Southern states other than Louisiana, but a little railroad travel, and reading and personal conversation with men familiar with the production of naval stores in Georgia, Florida and Alabama, convince him that Louisiana has at present far less second-growth longleaf and slash pine than the states which were earlier reached by the sawmill and naval stores industries. After a fairly wide observation of the longleaf region of Louisiana he does not hesitate to say that the area of second-growth longleaf and slash pine is insignificant as compared with the vast areas which were once covered with virgin forests of these species and have been cut over. In sharp contrast, I am informed that many hundreds of thousands of acres in South Carolina, Georgia, Florida, and portions of Alabama, which were logged off relatively early in the life of the Southern pine industry, have come back to splendid stands of second-growth. I have examined a few such stands in Florida, and the sight was impressive beyond all words. Why does this difference exist? Speaking in broad terms, lumbering in the more easterly states of the southern group was begun before steam skidders came into extensive use, and also before market prices for Southern pine justified extremely close cutting of the stand. The result has been that on the average cut-over area many of the smaller and defective trees were passed up by the fellers and remained uninjured when the larger trees were cut and removed. Quite unconsciously the early lumber operators practiced forestry to the extent of leaving on the ground an abundant number of seed trees, which, released from the competition of their over-topping neighbors, produced fair amounts of seed nearly every year, and very heavy crops perhaps once in seven or eight years. Coupled with the presence of seed trees, a somewhat greater freedom from fires (which destroy tree seedlings) has favored a second-growth of pine. More frequent roads, more numerous farms, and possibly a greater number of topographical barriers than in Louisiana, tended to prevent the spread of fires.

The bulk of the longleaf pine lands of Louisiana, which include also the slash pine forests near the Gulf in the Florida parishes, today presents a most desolate sight. Probably a good half of them have been logged with steam skidders, and at a late period in the development of the industry, when the lumbermen have believed that it is folly to leave a single tree standing which can be hauled to the mill and converted into "two slabs and a streak of sawdust." Less than 10 per cent. of the longleaf pine region of Louisiana is today farmed. Particularly toward the south, both in the Florida parishes and in southwest Louisiana, the flatness of the land has offered practically no break to the spread of fires, and the few roads have proved but a slight check to the flames. When asked what percentage of his company's lands were burned over every year, a forester once employed by a large lumber company in Louisiana answered laconically: "150." And indeed, in an ordinarily dry year large tracts will burn over at least once a year and a good portion of them twice a year. Again, portions of Louisiana are blessed, or cursed, depending upon one's point of view, by the presence of large numbers of razor-back hogs. In spite of the best efforts of the country demonstration agents the many Louisianians of the piney woods still cling to the idea that the razor-back hog is a profitable institution. In a sense, of course, they are right, but the havoc wrought in restricted localities upon the second-growth longleaf forests of Louisi-

Effect of Close Cutting, Steam Skidding and Repeated Fires in Longleaf. No Hope of Natural Reforestation, Because There Are No Seed Trees Left. Scene in Beauregard Parish, La.

ana has been enough to condemn the razor-back as an enemy of society. No one has yet had the hardihood to estimate the number of pounds of pine mast which a single long-legged razor-back can consume in a day, or how many thousands of succulent young longleaf seedlings he can root out of the ground and destroy. But it is certain, as has been conclusively proved by experiments in Louisiana, that in portions of the longleaf pine country where hogs range freely and in large numbers it is idle to hope for second-growth longleaf unless the razor-back is kept out. For example, in January, 1915, a count was made of the year-old longleaf pine seedlings upon ¼ of an acre near Urania, La., and again on an adjacent ¼ of an acre surrounded by a hog-proof fence. Outside the fence three years later but 30 out of the original 813 seedlings had survived the ravages of hogs, while within the fence the number had actually increased from 927 to 1,745. No fires occurred in either plot during the course of the experiment.

As a result of lack of seed trees, repeated fires, and in restricted localities razor-back hogs, the 5,000,000 acres of cut-over longleaf pine land in Louisiana today boast scarcely 100,000 acres of second-growth longleaf and slash pine, and probably very much less. But beyond any Southern state Louisiana awakened to the menace of her idle cut-over lands, and within the last few years has given much thought to bringing back upon such land a second-growth forest which we confidently expect will be the source of supply for great permanent forest industries, including the naval stores industry.

In all the present naval stores territory but one other state—Texas—has undertaken to perpetuate this great industry. South Carolina, Georgia, Florida, Alabama and Mississippi, with greater opportunities than Louisiana because of their larger areas of second-growth timber, have failed to take any action to protect and perpetuate their forests. By their neglect they are robbing themselves of a vast future wealth. By contrast, the naval stores industry of France is today on a permanent basis, and Louisiana is planning on achieving, in time, nothing less.

The remainder of this article will be largely concerned with a brief account of what Louisiana is doing to put to work growing trees on her now nearly idle cut-over longleaf lands, and to assure herself of a turpentine industry for all time.

In 1910 Louisiana passed her now famous severance tax law. Mr. H. E. Hardtner, president of the Urania Lumber Company, and then a member of the legislature, wrote the law, which was designed to supply funds for the establishment of a Division of Forestry in the State Department of Conservation. The severance tax was a new departure in tax legislation, and it was necessary before the tax could be collected to pass a constitutional amendment. The tax was substantially a yield tax, placed upon every thousand feet of lumber, and all forest products, which are removed, or "severed" from the soil. Before the law could become effective a new legislature diverted the proceeds from the tax from the Department of Conservation to the General Fund of the State, and it was only on the first of January, 1918, that the friends of forestry, including such staunch advocates as the present Commissioner of Conservation, M. L. Alexander, and the Professor of Forestry of the State University, Major J. G. Lee, were able with Mr. Hardtner's assistance to secure one-fifth of the severance tax for forestry purposes. Earlier legislation, dating back in part to 1904, had made it illegal to set on fire woods or cut-over lands belonging to another, had legalized the acquisition of state forests, defined the duties of the State Forester, required certain precautions in the matter of fire from the railroads, provided for reduced assessments of lands being reforested, and in general had laid the ground work for an effective state forestry department. Prior to 1918 the Department of Conservation, with such funds as it could spare from fish and game licenses, had conducted a propaganda in favor of the practice of forestry and had approved a reforestation contract with Mr. Hardtner covering 30,000 acres under the reforestation law.

For the past eighteen months the Division of Forestry of the Department has had available in the neighborhood of $1,000 a month from the severance tax on forest products, and $2,000 yearly from Federal funds to be used in co-op-

Unburned Experimental Plot Fenced Against Hogs. Note Height of Numerous Longleaf Saplings. Six Years Old. Note Ground Bare of Seedlings in Foreground, Where Hogs Have Rooted. Scene in La Salle Parish, La.

Razorback Hogs at Work. Where Plentiful Enough These Hogs Will Keep Out All Longleaf Second Growth. In Most Sections Far Less Serious Menace Than Fire. La Salle Parish, La.

erative work in fire control. The legislature of 1920, with the approval of Governor John M. Parker, has just appropriated $60,000 for each of the coming two years to be spent in forestry work. The same legislature passed the first law enacted by any state of the Union requiring those cutting the timber on land not susceptible of cultivation to leave standing on it at least one seed tree per acre. Greater powers were also granted the department to deal with railroad fires, and the reforestation contract law was extended in modified form to allow of contracts as short as fifteen years.

The Department of Conservation has in the past placed the greatest emphasis in its forestry work upon control of forest fires. Beyond any doubt this policy will be continued, and the greatly augmented funds will enable us to undertake a state-wide campaign for control of fire. Unless fires can be controlled it is out of the question for us to expect to raise a crop of any kind of pine. It is indeed true that longleaf and slash pine possess remarkable ability to withstand occasional severe fires, and their fire-resistance, even when only a year old, has been shown to be astonishing. (See photos). Nevertheless, fire will invariably stunt the growth of even longleaf and slash pine seedlings and saplings, and when occurring during the summer months will utterly destroy young growth up to ten and twelve feet in height. Whatever may be said for or against an occasional fire in a young stand, to remove the accumulation of straw and prevent severe damage from the subsequent inevitable fire, it is certain that fire entirely uncontrolled is in itself responsible for the utter absence of second-growth longleaf pine on hundreds of thousands of acres of cut-over lands in Louisiana.

There is little use in spending money for suppressing fires without an attempt to prevent their occurrence. A fire warden behind every bush in the piney woods could not prevent fires from burning, as long as the local people **wish** them to burn. In Louisiana more than 99 out of 100 fires are caused by human agencies. The railroads and tramroads have in the past been responsible for 20 per cent. or 25 per cent. of our fires. Careless campers, smokers, the burning of stubble fields, and of strips around the farmers' fences to protect them, are the cause of a like percentage of our fires. Sad to relate, certain turpentine operators have not been guiltless in the past of starting conflagrations which have swept many thousands of acres outside of their orchards. (We realize the necessity of raking and burning turpentine orchards, in view of the present state of public sentiment toward fires, and the frequency with which they occur. We have no thought of interfering with the practice of careful burning in turpentine orchards. We know well that the $500,000 which authorities calculate are annually spent in the South in protective burning of turpentine orchards would not be so expended if protection were unnecessary. On the other hand, we vigorously condemn the turpentine operator who permits fire to burn beyond the confines of his orchard, thereby working injury and hardship upon his neighbors). Most important of all, 50 per cent. of our fires are deliberately set, occasionally by the gatherer of light wood and pine knots who wishes to find his material more easily in the long grass, but more especially by the local stockman who believes that fire "improves the range."

If human agencies are thus responsible for practically all of our fires, it follows that any successful effort to control fires must be directed, for the present at least, very largely to the prevention rather than the suppression of fires. Until we can convince the people of Louisiana that fires are a menace to their prosperity we can hardly hope to meet the fire situation. We must educate the stockmen to the fact that under Louisiana conditions fire on the stock range is an unmixed evil; we must remind the farmer that fire destroys his fences, his buildings and occasionally his crops; we must bring home to the lumber operator that as high as 1½ per cent. of his standing pine timber may be burned off the stump by fire in a dry year, and that every year his logs, crossties, trestles, and logging equipment are consumed by fires; we must convince the sportsman that fires drive his game into the deepest and most inaccessible swamps; in short, we must bring home to every one of the many people who are responsible for fires that their ignorance and carelessness cost the state an average of about $1,000,000 a year. And most im-

Fourteen-Year-Old Slash Pine, Three to Seven Inches Breast High, Average Five Inches. Thirty-two Feet in Height. St. Tammany Parish, La.

Eighteen Years Ago the Floating Timber Was Cut Here and Young Longleaf Growth Started in the Openings. Ten Years Later the Remaining Virgin Timber Was Cut. No Skidders Used in Either Cutting. Fire and Hogs for Some Reason Were Infrequent. Beauregard Parish, La.

portant of all, we must bring home to the public the fact that unless fires are controlled we can never hope for any second-growth longleaf or slash pine.

Our campaign of education against fires is carried on chiefly by local patrolmen—plain, every-day citizens of the locality which they patrol. These men during the fire season are constantly on the road or in the saddle, and never lose an opportunity to preach to their neighbors and to passers-by the evil results of forest fires. In addition the men tack up along the wood roads and on buildings signs calling attention to the effects of fire and distribute literature on the subject wherever it seems likely to be read. They visit also the local schools, and address local gatherings of one kind or another. Their work is supplemented from New Orleans by special articles for the state-wide and local press, by lectures and addresses, by exhibits at the state fairs, and by every form of publicity which we can afford. The more progressive of our citizens we are convincing through our arguments, and the unregenerate we are restraining by the pre ence of our officers. It is a long row to hoe, and we have some of the most deep-rooted of prejudices to overcome, before we can eliminate fires from the piney woods, but we are confident that we are right, and that confidence goes a very long way toward ultimate success.

Fire control will eventually be attained by eliminating as far as possible the causes of fires. In addition to our educational work we are getting at a very important source of fires by regulating the type of stack and ashpan which are used by the tramroads and railroads, and in the future we expect good results from a new law which requires the railroads to clear a strip on each side of their track wide enough to form an effective fire line. Where the company does not own a right of way of sufficient width to make an adequate line, we can require the railroad to enter private land, the owner permitting, for the purpose.

The razor-back hog is hardly a problem for the forester. Just as the citizens of Louisiana have been won over to compulsory dipping against the cattle-tick, so in the future they will come to see the necessity for fencing up their hogs and the greatly increased profits which will come from less haphazard methods of hog raising. Here and there land owners engaging in timber growing will find it worth while to erect hog-proof fences, and to graze only cattle, sheep and goats on lands being reforested. But in our opinion the hog is greatly over-rated as a destroyer of young pine in most localities, although there is no doubt at all that in the neighborhood of settlements, or of bottoms which are the favored spot for the raising of range-hogs, no longleaf pine can be grown.

Second in importance only to the control of fire is the work of convincing the general public and the land owners that trees can be grown profitably in the state. In this connection we must work against not only prejudice but ignorance and indifference. To the enthusiast who believes that every acre of the cut-over pine lands will eventually be used for farming, the idea of raising trees is outlandish. Beyond any doubt whatever an increasing area in the piney woods is going to be devoted to crops, and certainly nearly all of it is going to be used for a more or less intensive grazing industry. But it is equally certain that possibly as high as 25 per cent. of the cut-over longleaf pine lands of the state are altogether unsuited for farming, and that for many, many years to come another large portion cannot be profitably used for that purpose. To proclaim these truths without the appearance of "knocking" the state, is not altogether easy, but when approached from the proper angle can be done. By "approached from the proper angle," I mean that we must show the possibilities on even the poorest land of producing wealth from growing timber rather than the impossibility of producing it by farming. In order to get the facts with regard to our cut-over piney woods land before the public, we have published bulletins of one kind and another, and by newspaper publicity, lectures, and word of mouth, have sought to enlighten the Louisiana public. Publicity and education we consider to be an extremely important part of the forestry work.

Roads Protected This Promising Young Stand of Longleaf Against the Annual Fires Which Swept the Adjacent Land. No Young Growth Where Fires Burned Annually. Hogs, However, Were Plentiful in Both Tracts, But Without the Help of Fire Would Not Destroy All Young Growth.

Slash Pine Along Old Tram Road, Fifteen Years After Abandonment. Average Six Inches in Diameter, Breast High, and Thirty-two Feet in Height. Off the Grade Fires Have Stunted the Young Growth Somewhat.

The co-operative state forest at Urania, which has been mentioned in connection with the reforestation law, has been an extremely valuable demonstration of the truth concerning reforestation. Not only have the owners of this property co-operated with the state and the Federal Forest Service in experimental work, but they have gladly aided in everything which will bring home to the public the significance of the facts regarding second-growth timber. The Louisiana Forestry Association makes it a practice to hold one meeting a year at Urania, where the results of reforestation may be seen at first hand.

A word concerning the provisions of the law under which the Urania tract was dedicated to reforestation will give a clearer idea of how Louisiana encourages such work. Under the old law any land which was not valued at more than $5 per acre was given a valuation of $1 an acre for a period of 30 to 40 years, provided the owner entered into contract with the Department of Conservation to reforest the land with valuable tree species. By reforesting was not meant the laborious process of artificial planting, with its excessive cost, but natural reforestation by the simple expedient of keeping fires out of cut-over land. Most of the land under contract at Urania was cut-over as early as 1902, and as many as five or six seed trees were left on nearly every acre. The trees were small and not worth cutting at the time, but in many instances have since grown as much in 18 years, as they had grown in the previous 125 years. Henry E. Hardtner the owner of the tract, declares that quite apart from the reforestation that results, the leaving of such trees is a good investment, owing to their increased growth. His ideas have recently been enacted into the seed tree law referred to earlier in this article. Such a law, effectively administered, will insure that in the future no land will be left in condition where natural reforestation is impossible unless it is to be used immediately for farming or improved pasturage.

By reasonable taxation, by a degree of fire protection, and by making known the possibilities of wealth to be derived from growing timber, Louisiana is insuring herself against the gradual disappearance of her forests. We believe that as the simple process of growing timber comes to be better understood, and the possibilities of financial gain from it are more clearly pointed out, capital is sure to be attracted to Louisiana to engage in the enterprise of forestry. As time goes on we expect to study carefully the rate of growth of all of our native trees, but particularly the slash and longleaf pines which are the basis of the naval stores industry. While our knowledge of their growth is today limited, we know enough to encourage us to further investigation. The following tables, based on growth studies made on the Atlantic seaboard, can undoubtedly be used as a general guide in figuring the returns from growing timber for naval stores in Louisiana.

These figures were derived from tables recently published by the United States Forest Service showing the dimensions and number of trees per acre in second-growth stands of longleaf and slash pine of varying ages, and from certain other Forest Service figures on the yield of gum from trees of different sizes. In other words, the writer has drawn his own conclusions from data originally collected by the Federal foresters.

There is one caution to be observed in applying these figures. They were based on studies in what the forester calls fully-stocked stands, that is, stands of timber where the trees grew close together, without any large openings. Cut-over lands in general, even when given partial fire protection, cannot be expected to grow as heavy stands of timber as these, simply because not all of the ground is covered with trees, and the openings may occupy as much as half, or even more, of the ground. In spite of this, the yield of naval stores which may be expected from the second growth stands of the future appears extremely attractive. Today, except during periods of abnormally high prices, such small timber cannot be worked as profitably as larger stuff. But 15, 20 and 30 years from now it is entirely reasonable to expect that the prices of naval stores, like the prices of lumber, will have reached a permanent level high enough to make extremely profitable the working of small second growth trees.

CORRECTION OF TABLE ON PAGE 244

NAVAL STORES YIELD TABLE SECOND-GROWTH SLASH PINE VIRGIN CROP

Age Years	Average D. B. H.* Inches	Number of Trees Per Acre	Cups Per Acre	PRODUCTION PER DIP Gum Lbs.	Rosin 500-Lb. Bbl..	Turpentine Gals.
20	6.4	525	253	190	.31	4.75
30	8.4	383	408	465	.77	11.62
40	9.8	323	446	578	.96	14.45
50	10.7	298	486	670	1.11	16.75

NAVAL STORES YIELD TABLE SECOND-GROWTH LONGLEAF PINE VIRGIN CROP

Age Years	Average D. B. H.* Inches	Number of Trees Per Acre	Cups Per Acre	PRODUCTION PER DIP Gum Lbs.	Rosin 500-Lb. Bbl..	Turpentine Gals.
20	5.0	450	50	31	......	....
30	6.9	355	210	187	.31	4.67
40	8.3	308	321	365	.61	9.12
50	9.3	280	371	460	.77	11.56

*Diameter breast high or 4½ feet from ground.

DEVELOPMENT OF THE WOOD TURPENTINE AND WOOD ROSIN INDUSTRY

(By Walter B. Harper, Chemical Engineer.)

[Mr. W. B. Harper, chemical engineer, of Atlanta, Georgia, has been connected with the wood distillation industry for about seventeen years. He has erected a number of destructive plants and operated a few solvent and steam process plants. More recently he was Plant Manager of the first plant of the Newport Turpentine & Rosin Co., and Chemical Engineer of the Hercules Powder Company, and afterwards consulting chemical engineer, located in Atlanta. Mr. Harper is author of the book entitled "Utilization of Wood Waste by Distillation," and also the chapter on the "Destructive Distillation of Wood" in Roger's-Aubert "Manual of Industrial Chemistry." He is a graduate of the Massachusetts Agricultural College and the Virginia Polytechnic Institute.]

WHEN one looks back over the years of trial and tribulation endured by the pioneers in the wood turpentine industry, it seems surprising that the industry should have at last reached a place of commercial importance.

The apparent simplicity of the first process, which can be carried out by heating a piece of wood in a large-sized pipe, has attracted many an investigator in this line and held his interest from year to year in spite of commercial failure. Perhaps no industry has had such a number of enthusiastic men. Hopeful to the extreme, statements of prospective profits assumed exaggerated forms sometimes, which continued failures did not seem to modify. Yet time has proven that, in the main, these assertions of values in wood have been true and that it was only necessary that market conditions change but slightly to put the industry on its feet and make it a dangerous competitor to the regular naval stores industry.

Every year, for the past fifteen years, the notice has appeared in the trade papers that a new process has been discovered which will "revolutionize" the industry. Always these claims have not materialized.

Before 1865 attempts were made to utilize the resinous portions of pine wood. A description of the patents of those days discloses the fact that much of the information we possess concerning wood turpentine was known then. Even the use of steam as an adjunct to direct fire was advocated.

The process first used as a retort proposition is known as the Destructive Distillation Process. The names of many men and companies using this process might be given, many of whom, although unsuccessful themselves, have contributed their share to the interest and information concerning this process. In the early days the names of Stanley, Wheeler, Hansen and Koch were familiar, and a little later Matthier, Clark, Gilmer, Mallonee, Bilfinger, Mariner and Wernicke were well known. Some of these are still actively engaged in the industry. Of the companies, The Georgia Pine Products Co., The American Turpentine & Tar Co., The Pensacola Tar & Turpentine Co., and the Spirittine Chemical Co., might be mentioned as those who have been able to stand through the years with more or less financial success. Perhaps if these companies had engaged in some other line of business and used the energy and aggressiveness put forth in this line, their financial rewards would have been far greater. (See foot note.)

Although the use of steam as a means of extracting turpentine had been foreshadowed it was not until the advent of the "hog" that the process was fully developed. The "hog" made it possible to grind up the wood fine enough for the steam to act on the turpentine in the wood. Immediately a large number of plants were started to work on this process, but the low yields of turpentine coupled with the low price, caused all of them to fail.

These plants, however, made such a good quality of turpentine that a permanent market was established. This was their contribution to the industry.

Along about this time (1900-1907) the idea was conceived of extracting the rosin as well as the turpentine. This was soon put into practice. The idea occurred to a number of men at approximately the same time, but only a few were able to raise the funds necessary to erect a plant. At the start the Yaryan Naval Stores Co., Newport Turpentine & Rosin Co., and the Williamson Chemical Co., became quite well known in the industry in the order named. These companies also had their difficulties and the profits from their operations have not been much until the past few years, when they became more firmly established.

The industry as it now stands centers around the two processes, the Destructive and the Steam Solvent.

DESTRUCTIVE PROCESS: The Destructive Process consists in heating the wood in a closed receptacle called a retort, which has an opening leading to a condenser, by means of which the vapors escape from the retort and are condensed. The retort is enclosed in a brick furnace. There are several types of these retorts that are in use varying as to size, shape and construction.

Small retorts consist of cylindrical iron vessels, supplied at one end with a door for the entrance of the wood and withdrawal of the charcoal. Larger retorts are made rectangular in shape and built long with rails on the bottom. Cars of wood are pushed directly into these retorts and the wood distilled on the car. This type of retort is a modification of a French retort used in the hardwood industry. It has proved satisfactory in the pine wood industry also. This process makes wood turpentine, pine oil, refined tar oils, flotation oils, pine tar and charcoal. At one plant acetate of lime, wood alcohol and creosote carbonate are also made.

Attempts to modify the process by first distilling the turpentine by means of a rosin bath, or by external heating of the retort with hot oil, have proven to be unnecessary in the light of modern refining methods.

As the effect of the furnace fire upon the iron of the retort has been injurious in spite of brick baffles, a modified retort has been introduced which seems to have considerable merit.

This retort is made of reinforced concrete. The heat is supplied from the furnace by means of cast iron flues hung directly inside the retort. The de-

The first commercial work in the distillation of pine wood in the United States is credited to James Stanley, who built a small plant in Wilmington, N. C., in 1872. This plant was not a success in the hands of Stanley, and was shortly after taken over by two gentlemen of Danish birth, who were somewhat familiar with similar work which was being carried on in their motherland. One of these men was Mr. L. Hanson, afterwards president of the Spirittine Chemical Co. of Wilmington, N. C. The process as started by Mr. Stanley and carried out by Mr. Hanson, was the old crude method of destructive distillation, which consisted of a serios of retorts with condensors attached, set up on brick work with furnaces beneath. The wood was placed in the retorts and the doors closed, fires started in the furnaces and kept up until distillation ceased; the retorts were then allowed to cool and the charge was withdrawn. No attempt was made to control the temperature during distillation and it was not until years later that the possibilities of varying products depending on the temperature was thought of. By this old method many different degrees of heat existed in the retort at the same time. There was no attempt at first to refine or separate these products. They were pumped into storage tanks and used for the preservation of timber, a creosoting plant having been built nearby, and the creosoting of timber was a part of the company's business.—Thomas W. Pritchard, in address to the New York Section of the Society of Chemical Industry, in 1912.

structive action of the fire is thus confined to the cast iron flues which are better able to stand it than a steel retort. The flues, though, cause considerable trouble.

THE STEAM AND SOLVENT PROCESS consists in grinding the wood by means of a hog and shredder, then steaming it to remove turpentine and some pine oil. The residue is extracted with gasoline forming a solution of rosin and gasoline. By distilling off the gasoline the rosin remains behind. This seems to be a very simple process, but its actual working requires considerable skill and careful operation to avoid extreme losses in gasoline. As a means of completely utilizing the wood, this process comes nearer than any now in operation. This process makes wood turpentine, pine oil, flotation oils and rosin, all of which products are of very good grade.

A further description of the various processes will be found under articles dealing with special plants.

To bring these processes to their present standing has required the efforts of many men. In the early days, in order to make a better showing, many mistakes were made. Quality was sacrificed for quantity, with the result that sales became slow or ceased entirely. If the quantity was not obtainable the plant did not succeed. If quality was maintained the returns were not sufficient to justify continued operation. Another trouble which still persists is the attitude of the brokers who would sacrifice the success of a plant in order to make a large margin on a sale. The main cause of failure of the early plants was due to the fact that they were ahead of the times. As long as the supply of the regular naval stores remained abundant there was not much hope for the industry, except in one or two instances, where local conditions made it possible to operate.

The discovery of the value of various wood oils for flotation purposes opened a way for the sale of these products at a favorable price and gave an impetus to the industry that carried it through the war. Since then it has become apparent that the regular naval stores industry is on the wane. Trees for tapping purposes are difficult to obtain and then only by payment of large royalties for the leases. The labor conditions further demoralized the regular gum distillation until at one time the production was only about one-half of prewar conditions. The advance in the price of naval stores stimulated renewed endeavor to increase production, but so far it has amounted to only about 40 per cent. increase over the lowest year.

This scarcity of naval stores with its resultant high prices, has helped the wood turpentine industry to maintain itself and it is becoming apparent every day that it can be produced as cheaply as the regular gum article. As a substitute for the gum spirits it is sold at a lower price, but it is giving as good satisfaction. Where it is found to be unsatisfactory, the trouble is simply due to poor manufacture.

The commercial uses of wood products are practically the same as those of the regular naval stores. The additional oils made by the destructive process do not amount to much in quantity and have special uses.

The cost of these plants varies widely, according to the size and special arrangements for insurance provisions. The average would be approximately $4,000 per ton of wood extracted in 24 hours for the steam solvent process and $3,000 per cord distilled in 24 hours by the destructive process.

The yield of products by the solvent process would be about 10 to 11 gals. per ton of stump wood and one to 1¼ small barrels of rosin. The destructive process will yield from 80 to 100 gallons of oils and 35 to 40 bushels of charcoal per cord. The oils from the solvent process are mostly turpentine and pine oil. The oils from the destructive process are mostly the so-called tar oils and pine tar. The steam process turpentine and pine oils command a higher price and have a readier sale than the destructive.

There seems to be an increasing demand for wood products and this is being supplied by new plants. The margin of profit is being reduced as the prices fall but it has been as much as 25 to 50 per cent. by each process. With closer competition new plants will have to be carefully designed in order that the various parts of the operation will be balanced. By using care in the selection of the process to suit conditions and in the erection of a properly designed plant, there is still a limited field for a few more plants using either process.

The present plant capacity amounts to about 800 cords of wood treated daily. This is about equally divided among the two processes. New plants are in course of erection but the daily capacity of the solvent plants will be much larger than that of the destructive.

The success of a plant will depend upon a number of conditions. The location of a plant is a very important feature. When freight rates on wood were relatively low it was customary to build plants some distance from the woods and near large towns. Now that conditions are changed the location of the plant in respect to its distance from the wood supply is a very important item. The scarcity of cars for transportation purposes has been felt very appreciably by those plants dependent entirely upon railroads for the supply of wood. Even with a good supply of raw material available, a great many plants work under a disadvantage, owing to poor initial design. Some of them just grew up. Good quality of products can be made from the raw material, but at great inconvenience and considerable expense. In the early days this feature of poor original design brought more misfortune to the company operating than perhaps any one item.

The operation of both the destructive and solvent extraction processes is a comparatively easy matter on a small scale, but a relatively large plant requires skilful operation to obtain economical results and the maximum production. Technical skill of a high order, both chemical and mechanical, should be employed to obtain the best results. In the early days the chemist was not considered important except to use his report for selling stock. We are responsible to him for the improvement in quality of the various products now made. The color and odor of wood turpentine is much better than formerly and its actual turpentine content, as contrasted with heavy oils, is much greater. We look to him for the standardization of the products and the discovery of new uses.

The engineer was also formerly despised. Any old shack would do to house the plant and the plant itself would be made out of scrap iron. Conditions have now changed and we find plants economically designed and built, yet symmetrical and good to look upon.

As mentioned before, the selling end of the business has been usually weak. Reliance has been placed in great measure upon brokers who have often left the plant broke. To some extent this feature has also changed. There are reliable brokers who are handling all the products and doing business on a fair basis. Selling agencies are being formed by some companies which will be of great benefit to themselves and others in the industry.

At present the differential between the selling price of gum products and wood products is far greater than it should be. The wood products have sufficient merit to command a worthy price. The turpentine as produced by some concerns is even better for some purposes than the gum spirits. A better understanding among the producers would tend to correct this condition and improve the market conditions all around.

At present the wood turpentine industry seems to be a permanent fixture in our commercial life which will last as long as the supply of stumps. One wonders, sometimes, if the stumps were not made difficult to remove so that they might be saved for a time when needed to supply a demand for a natural resource.

WOOD ROSIN AND TURPENTINE VS. GUM ROSIN AND TURPENTINE

(By J. E. Lockwood.)

[Mr. J. E. Lockwood first became connected with the naval stores industry through his employment by capitalists to investigate, test and assist in perfecting the "Yaryan Process" (invented by Homer T. Yaryan of Toledo, Ohio) for extracting rosin and turpentine from pine stump-wood and fat pine waste-wood, by means of steam and a volatile solvent. On the organization of the Yaryan Naval Stores Company, to build and operate Yaryan plants, Mr. Lockwood was appointed General Manager and directed the design, construction and operation of the plants at Gulfport, Miss., and Brunswick, Ga., and also directed the sale and use of the products made. He remained with the Yaryan plants until the fall of 1914, when he severed his connection with the naval stores industry. In the spring of 1920, he again became connected with the Yaryan plants and is now Director of Sales for the Naval Stores Division of the Hercules Powder Company. Mr. Lockwood has a firm faith that naval stores wood products will be steadily improved until they are of superior quality and value to any naval stores products now made and that their production will then increase until it becomes the principal source of the world's supply of naval stores products.]

FOR more than a century the world has depended on the United States as its principal producer of naval stores, the principal products of which are rosin and turpentine, which products have steadily become more and more important for use in the arts and commerce.

This article is written for the purpose of explaining why two classes of naval stores products are now being produced, first, gum rosin and gum turpentine, which is the class first produced and which still comprises the greater portion of the naval stores production; second, wood rosin and wood turpentine, the newer class of comparatively recent development. It will also bring out the reason for the existence of the two classes set forth and the relative merits and possibilities of their respective products.

The world's demand for rosin and turpentine and the United States' production of same, have steadily increased from a very small beginning, in about 1800, until the maximum was reached in 1908. The United States' production then constituted more than 80 per cent of the world's production, and amounted to 2,500,000 round, (500 lbs.), barrels of rosin and 750,000 barrels, (50 gals.), of turpentine, of which production more than half was exported.

Until about 1908 all rosin and turpentine was produced from the gum, (oleoresin), which exudes from the live pine trees, and which, in consequence, was known as "gum rosin" and "gum spirits of turpentine," the only exception being that some "wood turpentine" had been produced during the latter part of this period by destructive distillation and steam distillation from fat pine waste wood, but no rosin other than "gum rosin" had been commercially produced up to this time.

The source from which gum rosin and gum turpentine had been produced was the virgin pine forests of the South, which had been so largely depleted in the production of naval stores and lumber that it then became apparent that another source of supply for naval stores must be found, or, as the remaining virgin pine forests were exhausted, the production of naval stores therefrom would cease and no further supply be available for the world's needs.

Realizing this need, many applied themselves assiduously to this problem, but without success until the invention of the steam and solvent process for the extraction of rosin and turpentine from the pine tree stump-wood and the fat pine waste-wood, which raw materials were available in great quantity on the cut-over pine timber lands of the South.

The first plant for producing wood rosin and wood turpentine by the steam and solvent process was built at Gulfport, Mississippi, in 1909, and in 1910, its first year of operation, it produced, in round figures, 14,000 barrels of wood rosin and 2,000 barrels of wood turpentine, both products of good quality, which found a ready market among naval stores users. This first year's production of wood rosin and turpentine amounted to only about three-quarters of 1 per cent of the total United States naval stores production of that year—a small beginning but one destined to lead eventually to great progress and important results in the naval stores industry.

Since 1910 the production of wood rosin and wood turpentine has steadily increased and these products have, in consequence, become a more important part of the naval stores industry, it being estimated that the 1920 production of wood rosin and turpentine amounted to approximately 10 per cent of the total United States naval stores production of that year.

It is now generally recognized that as the dwindling virgin pine forests of the South are exhausted and, in consequence, the production of gum rosin and turpentine therefrom decreases, the users of naval stores must look to producers of wood rosin and wood turpentine to make up for this decrease. In consequence, wood rosin and turpentine are thus destined to eventually become the principal products of the naval stores industry.

Next, as to the relative merits and possibilities of wood rosin and wood turpentine, as compared with gum rosin and turpentine:

Gum rosin and gum turpentine, the original and still the principal products of the naval stores' industry, have been, and still are, produced under such primitive conditions and by such methods, as preclude any material change or improvement in these products, or the production of products of a uniform character. In consequence, the gum products, as now produced, are similar in character to those produced nearly a century ago, with the exception, only, that due to the introduction, and now general use, of the "cup and gutter" system for the gathering of the crude gum from the pine tree, the percentage of pale, (light colored) rosins produced has increased, and of common, (dark colored) rosins has decreased, as compared with the production of former years, but the character of these products remains the same.

Gum products, as produced, have therefore been generally accepted as standards of quality, without recognition of the fact that products of higher quality and greater uniformity could be produced under different conditions, with improved methods and proper control. It has therefore been accepted, as necessary, that any improvement, or change, in the character of gum products to make same suitable for various uses, must be effected independent of their production and this has generally been done by users of these products, who have in consequence, had to complete the process of production to obtain products suitable for their various uses.

Gum turpentine has, in consequence, been produced in one grade only, with such limitations in the range of its specifications as covers the variations in quality, which naturally result from the primitive producing conditions and methods mentioned, or, from carrying this product in storage until required for use, without later re-distillation.

Gum rosin, as produced, has been divided, according to color and cleanliness, into thirteen different grades, from B, the lowest and darkest colored grade, to W.W-Extra, the highest and

lightest colored grade, which grades have been arbitrarily established as logical classifications by color, rather than by quality, as required for various uses.

Wood rosin and wood turpentine have been produced in plants of relatively large capacity, which are completely equipped with machinery, apparatus and appliances of the latest improved character and operated under the direction, and constant supervision, of experienced technical men, thus providing complete chemical control. It is therefore apparent that these conditions permit the production of products of higher quality and greater uniformity, with possibilities of further improvement limited only by the basic character of the products themselves.

Pure wood turpentine, of the highest quality, regularly produced by steam distillation, is now generally recognized by users as being equal in all commercial respects to gum turpentine. This is evidenced by the present United States Navy Specifications, which make no distinction between wood turpentine and gum turpentine, also, in the consumption of large users of turpentine, who have compared and tested wood and gum turpentine thoroughly and found no essential difference. In fact, the greater uniformity of wood turpentine, its freedom from high boiling point fractions and its low acidity, which latter quality greatly reduces the possibility of discoloration when stored in iron tanks, or containers, are considered by some users as warranting a preference in its favor. Further, wood turpentine, which is first produced as a crude steam distilled turpentine, and then re-distilled to produce the commercial, refined product, can in re-distilling be made to produce whatever grade of refined turpentine is desired, thus insuring the delivery, at the time of use, of turpentine of the highest possible quality and uniformity.

Wood rosin, as originally, and as still produced, is generally of E or F grades, which for most purposes are equal to gum rosin of similar, or lower, (darker-colored) grades. Wood rosin has a characteristic reddish or "ruby" color and when subjected to high temperature darkens somewhat more than gum rosin of similar grades and for color requirements is therefore slightly different from, and not quite equal to, gum rosin of similar grades. For other than color requirements, however, it is of superior quality, being very uniform, and owing to the solvent method of production is absolutely clean and free from dirt, trash and foreign matter, which qualities make it preferred by many users for a great variety of purposes.

Twelve-Year-Old Longleaf, Ludington, La., Planted Six Feet Apart Each Way.

As wood rosin is produced under conditions, as described, which permit unlimited change in equipment and methods to secure improvement in quality, it is therefore apparent that improvement in quality and the production of various grades, suited for all purposes, for which rosin is used, or required, is undoubtedly a possibility, but one which will require extensive and thorough research and experimental development work, supported by ample capital resources, and backed with the courage to apply same to this work without expectation of immediate returns but depending for ultimate results upon the investor's fitness, persistence and success in this field of endeavor.

The wood rosin and turpentine industry is therefore not one to attract investors who are looking for large and quick returns on capital invested or the quick and easy development of its possibilities, as the full development of this industry must naturally depend upon first a decreased supply of gum products to provide a demand for wood products, and second, the production of wood products of improved quality to meet fully the requirements of all users.

The many failures and losses, which the wood rosin and turpentine industry has gone through since 1910 and yet survived, indicates the fundamental merit and possibilities of this field of endeavor and present conditions of the industry insure its being carried forward until its products are developed to their full possibilities.

Users of naval stores may therefore expect to ultimately depend on the wood rosin and wood turpentine industry, as their principal source of supply and may ultimately expect from this industry products of higher quality and greater uniformity than any naval stores now produced.

FUTURE MINOR SOURCES OF NAVAL STORES

A number of minor sources of naval stores supplies will undoubtedly be worked in coming years. Among the more prominent are the pine forests of Honduras and Nicaragua. Americans hold timber concessions for that purpose in both Brtish and Spanish Honduras, and probably in Nicaragua as well. The pine trees in these Central American countries are said by those who have studied and worked them to be prolific of oleoresin, the natives easily trained for the work, and the forests will eventually be given up to turpentine operations. It is not unlikely, in view of the disappearance of the pine forests in the United States, that the Central American governments may endeavor to regulate naval stores operations somewhat on the lines adopted in France, with a view to perpetuating the industry when it is once established there on a firm footing.

Scattered throughout the world are other potential sources of turpentine and rosin. In Australia, for instance, it is stated, in a book on the pines of that island continent published some years ago, the Kaure pine grows to the height of 150 feet and its oleoresin furnishes fourteen per cent. of turpentine New Caledonia is also said to have forests of these pines and others, and South Africa likewise is claimed to be a probable source of naval stores in coming years through acclimatised maritime pines, that tree, it is stated, showing wonderful adaptability to the climate and soil.

THE DISTILLATION OF RESINOUS WOOD IN THE SOUTHERN STATES

(By Dr. L. F. Hawley, in charge Section of Derived Products, U. S. Forest Products Laboratory, Madison, Wis.)

THE distillation of resinous wood is carried on principally in the South where the plants are widely scattered in the pine-woods region.

The wood generally used is that of long-leaf pine, this species being also the source of turpentine and rosin obtained by tapping the live tree; the turpentine produced in this way is known as "gum turpentine" and should not be confused with the product obtained by distilling the wood, which is known as "wood turpentine." At some plants a small proportion of short-leaf pine, loblolly pine, and other species may be used, but for the best results long-leaf and Cuban pine are selected. Since the valuable products come mostly from the resin in the wood, the most valuable raw material for the distillation process is wood rich in resin.

Ordinary long-leaf pine timber or the average sawmill waste or logging waste does not contain sufficient resin to make it a satisfactory raw material for distillation. It is only the especially resinous or pitchy portions of the tree which are suitable. These pitchy portions of the tree are selected naturally or may be selectd artificially in the course of lumber production so as to yield commercial quantities of a highly resinous wood. When a long-leaf pine tree falls or is cut and is allowed to lie upon the ground the resinous portions resist decay for long periods of time, while the less resinous portions, particularly the sapwood, decay rapidly and disappear. The remaining material is called "lightwood," "fat wood," or, in case of the conical shaped pieces of pitchy wood from the base of the limbs, "pine knots." In the same way the sapwood and less resinous portions of the heartwood of the stump decay, leaving a core of pitchy heartwood. This lightwood and old stumpwood make up most of the pine wood used for distillation. In large sawmills considerable quantities of pitchy slabs and trimmings can be selected from the waste conveyors, but this is not often done.

The resinous wood of other species, such as the Norway or red pine of the North and the Douglas fir and Western yellow pine of the West and the Northwestern States, have attracted attenion as raw material for distillation. As a rule, however, the efforts to use these species have not been very successful because either (1) the average resin content is considerably lower than for long-leaf pine; or (2) the wood has had to be especially selected to give commercially profitable yields; or (3) the cost of obtaining raw material was high, as, for example, the stumps of Douglas fir which are very large and difficult to pull.

DESTRUCTIVE DISTILLATION OF YELLOW PINE.

DISTILLING APPARATUS: The retorts commonly used vary in capacity from one to ten cords. These retorts are usually horizontal, cylindrical, steel vessels set in batteries, in brickwork, with the firebox at one or both ends, and are charged and discharged through doors at one or both ends.

The larger retorts usually are loaded with wood on cars while the smaller ones are charged and discharged by hand. Some of the larger retorts are of concrete heated on the inside by iron flues running the full length of the retort. In some cases also the bottom of the retort is not heated and part of the products are drawn off from the bottom of the retort while the rest are distilled through an outlet pipe to the condenser.

The firing methods vary at different plants from 24 to 48 hours being required to finish a distillation.

Vertical retorts with their long axis upright have been used to some extent in place of the horizontal type.

PRODUCTS: The original crude products obtained at most plants consist of (1) charcoal, (2) noncondensable gas, (3) oily layer of distillate, and (4) watery layer of distillate or pyroligneous acid; (2), (3) and (4) pass from the retort through a condenser where (3) and (4) are condensed; (3) floats on top of (4) and contains the most important and valuable products. The crude oil product (3) is not always obtained all together, but may be produced from the retort in various fractions. For instance, in some plants a first distillate or crude turpentine is collected separately at comparatively low temperatures followed by the other regular products at higher temperatures. In other plants, as mentioned above, the very bottom of the retort is not heated and the less volatile products collect here and are drawn off from time to time as a pitch or tar, depending on the temperature to which it has been subjected.

There is no standard practice in preparing final products from the crude oily distillate since the uses for the products are various and different plants have developd special products for the markets with which they are closest in touch. In general the products can be divided roughly in order of gravity and volatility (the lightest coming first) into wood turpentine, destructive pine oil, tar oils, and pitch.

The charcoal is either cooled in the retorts or raked out hot into cans and sealed air tight or in the case of retorts with cars, the cars are run out into closed coolers of about the same size and shape as the retorts.

The gas is usually burned under the retorts or boilers but is sometimes allowed to run to waste.

The pyroligneous acid contains wood alcohol and acetic acid like the pyroligneous acid from hardwood distillation, but in such small quantities that in general they will not pay for the cost of recovery.

YIELDS: Since few plants operate under the same conditions and since various products may be obtained from crude oil, it is difficult to estimate the average amount of products obtainable from yellow pine. Moreover, the wood itself varies widely in resinous content. The following table shows as nearly as

practicable the ordinary yields per cord (4,000 pounds) of yellow pine "lightwood" obtained in practice by the destructive process:

Refined turpentine......	8 to 15 gallons
Total oils, including tar	65 to 100 gallons
Tar	40 to 60 gallons
Charcoal	25 to 35 bushels

USES OF PRODUCTS: Wood turpentine obtained by destructive distillation is commonly sold as a second grade turpentine inferior to gum turpentine largely on account of its bad odor, although there appear to be some uses for which this peculiar odor is no disadvantage. It is used for some of the same purposes as gum turpentine by the paint and varnish manufacturers, although generally for outside work. Its actual composition differs considerably from gum turpentine, although its properties aside from the odor are not very different.

The destructively distilled "pine oil" is made to conform as closely as possible to the constants of the steam distilled oil and is used for some of the cruder purposes of the latter such as in paints, flotation oils, disinfectants, etc.

The tar oils are used for paints, stains, disinfectants, medicines, soaps, flotation oils, etc.

The tar has a large number of miscellaneous uses, the most important of which are in the manufacture of cordage, oakum, soaps, coating and binding materials, medicines, disinfectants, etc.

The uses for charcoal are the same as for hardwood charcoal as domestic fuel, for charcoal iron blast furnaces, for gunpowder, etc. The use of charcoal for domestic fuel is much more common in the South than in the North.

The pyroligenous acid is occasionally sold as a disinfectant or for making "iron liquor" (crude acetate of iron) but much of it is run to waste for lack of a market.

There have been many small destructive distillation plants built in the South in the last year or two which seem to have been successful in spite of small size. This is on account of the fact that there has been a fair market for the crude oils obtained direct from the retorts without refining and therefore the expensive refining apparatus, which is unduly expensive for small plants, is not required.

A destructive distillation plant without refining apparatus can probably be built for $2,500 per cord per day capacity; with complete refining apparatus the cost would be about $3,500 to $4,000.

EXTRACTION PROCESS.

This is the name commonly applied to the other main process for obtaining the resinous products from long-leaf pine wood. It is also sometimes called the "steam and solvent" process. In this process the products already present in the resinous wood are simply removed from the wood without change, whereas in the destructive distillation process new products are made by the decomposition of the wood fibre and the resin in the wood. The turpentine and pine oil in the original wood are obtained more or less unchanged in the products of destructive distillation but they are contaminated with other oils produced in the process.

For the ready removal of the resinous products the wood is first "hogged" into chips, then "shredded" into still smaller chips and loaded into vertical cylindrical digesters or extractors. Here live steam is blown through the chips to remove the turpentine and most of the pine oil. The steamed chips are then boiled with a solvent, usually a special fraction of gasoline, to dissolve out the rosin. This dissolving or extraction is carried out not in a single treatment but in a series of treatments in which each charge of steamed chips is washed with several batches of solvent in succession and each batch of solvent is used on several charges of chips. This series of treatments is arranged according to the common multiple extraction process, which is used in many industries. After a charge of chips has received its last washing with solvent, the solvent is drained off and the chips are again steam distilled to recover the residue of solvent which still remains on them.

These operations require a series of digesters or extractors, one part of which contains chips which are being steam distilled for turpentine, another part, chips in various stages of the extraction process, and another part, chips which are being steam distilled for solvent recovery; one extractor is also in the stage of charging or discharging the chips. These various operations progress successively from each extractor to the next in order until a cycle is completed.

The crude turpentine is separated into refined turpentine and refined pine oil by redistillation with steam. The solution of rosin (and some pine oil) in the solvent is cooled by a water spray in order to remove a rosin impurity which is insoluble in cold solvent. The washed solution is distilled to remove and recover the solvent and then the last traces of heavy oils are removed from the rosin by blowing steam through the rosin heated by closed steam coils. The dried rosin is then ready for barreling.

The average yield of products by this process from a cord of good quality stumps and lightwood is about 12 gallons turpentine, 5 gallons pine oil, and 550 pounds rosin. The turpentine is more nearly like the standard gum turpentine than the destructively distilled wood turpentine and is used for the same purposes. Pine oil is used as a flotation oil, in the manufacture of disinfectants, sprays, medicines, paints, varnishes, perfumes, and in other places where a pleasant smelling, high boiling, solvent is required. Wood rosin has many of the same uses as the corresponding grades (E and F) of gum rosin but its color is slightly different (it has a reddish tinge) and this interferes with its use in making paper size in cases where the size is to be used on white papers.

The cost of construction of extraction plants will naturally vary with local conditions and the costs seem unusually high at the present time. Such plants cost about $4,000 to $4,500 per cord per day capacity.

EXPORTS FROM THE RUSSIAN BALTIC PROVINCES

A REPORT of the United States Department of Commerce on "Russia" (December, 1920) gave the following as the latest available figures of exports from the Baltic Provinces, the figures representing poods of 36 lbs. avoirdupois each:

Year.	Rosin.	Tar.	Turpentine.
1910	22,337	396,494	245,556
1911	83,220	406,862	264,248
1912	116,462	356 568	145,580
1913	282,324	83,821	49,959

DESTRUCTIVE DISTILLATION OF WOOD AS APPLIED TO THE NAVAL STORES INDUSTRY

(By Eugene B. Smith)

[Mr. E. B. Smith for eleven years was prominently connected with the hardwood distillation and charcoal iron plants of Michigan and Wisconsin, holding various positions from chief chemist to manager of some of the largest plants in the country. During the past ten years he has been connected with the pinewood plants of South Carolina, Georgia and Florida, accumulating experience in the designing, construction and operation of the following types of plants: Steam process, rosin bath process, solvent extraction process, and the destructive distillation process in three different plants. For over five years he has been chemical engineer of the Florida Wood Products Company, at Jacksonville, Fla., which operates the largest destructive distillation plant in the industry. His long and varied connection with the industry gives a distinctive value to his statements and opinions.]

THE distillation of wood for the manufacture of the various products that go into naval stores, is confined in this country almost entirely to that section of the South where the wood of the long leaf pine can be obtained.

There have been a number of attempts to introduce this industry into Michigan, Minnesota and perhaps other states where stumps from Norway pine are available, but as yet none of these plants has been successful.

There have also been several attempts to work the Douglas fir of the Pacific Coast, but these enterprises have mostly shared the same fate as the ones operating on Norway pine. Therefore, for our present purpose we will consider only the plants operating in our Southern States and following the belt of long-leaf pine extending along the Atlantic and Gulf Coasts from Virginia to Texas.

The wood used for this purpose is almost entirely what is called lightwood and is practically all obtained from dead timber from which the sap wood has rotted away and from the stumps which remain after the saw mills have removed their timber.

A certain amount of good wood can be obtained from sawmill waste, but it must be carefully sorted as probably not more than five or ten per cent. of ordinary saw mill waste is fat enough to be used in a wood distilling plant.

This is a fact often overlooked by people who deplore the great amount of valuable material allowed to go to waste by our saw mills.

This same point applies to the dead timber on the land—good sound stumps from which the sap wood has decayed will usually yield wood rich enough for distillation. This applies to the stump above the ground and for a few inches below, but the long tap root is usually worthless.

This stump wood is probably the best material obtainable in this industry and the supply is almost inexhaustible, but the difficulty and expense of removing the stumps and breaking them up into sizes that can be handled has restricted their use and the greater part of the wood used in the past has been cordwood obtained from the dead and down timber.

This wood has to be very carefully sorted to obtain a grade that will yield a profit.

Many people have been misled and many plants have proved failures because this point was overlooked. On inspecting a piece of land it frequently seems to be literally covered with lightwood, but on close examination it will develop that out of all the wood in sight perhaps not over one-half cord per acre will be wood suitable for distillation. Also many tests have been made on picked samples of wood with such promising results that a company has been organized and a plant built only to find that it is impossible to obtain wood in quantities that will yield results anything like the test runs.

These facts are mentioned because disregarding them has caused a large number of failures and brought the industry into disrepute for a number of years.

This condition was also augmented by promoters with patented processes which somehow never seemed to work out satisfactorily in practice. A lack of a thorough understanding of the mechanical and chemical processes involved has also been a severe hardship to many of the enterprises in this line.

Probably the earliest commercial attempt at pine wood distillation, and a process which still is of a considerable importance, is the manufacture of pine tar by the kiln or pit process. By this plan fat wood is piled in a pit or brick kiln, so arranged that the tar, when formed, runs to a point where it may be collected and dipped into barrels.

If a pit is used, the wood is covered with earth, and if a brick kiln this is closed nearly air tight and the wood burned very slowly until charred. In this process nothing is recovered but tar and charcoal.

On account of the small expense for the plant and the ease of operation, considerable pine tar is still made by this process and comes on the market as kiln tar.

From this crude beginning there has been gradually evolved the modern wood distilling plant with its complicated equipment of retorts, condensers, stills, tanks, etc., and its output of twenty or thirty products, each chemically controlled and made to exact specifications to suit the special needs of a great variety of users.

In the development of this industry there have been a number of different processes used; some of which were operated on quite an extended scale and later abandoned as unprofitable, others have been modified and extended until they have become the standard practice at the present time.

In passing, it might be well to mention a few of these processes and how they have developed. The Steam Process—this was one of the earliest developments and a number of years ago the South was dotted with plants of this kind.

In this system the wood is cut into chips, usually with a saw mill hog. The chips put into an iron retort and steam blown through them under low pressure, the vapor passed through a water cooled condenser and the distillate allowed to separate by gravity, when a mixture of impure turpentine and pine oil is ob-

Upper Illustration—View of Refinery: On the left are three stills with fractionating columns for the recovery and refining of wood alcohol. On the right four stills with fractionating columns used in refining turpentine, pine oil and light solvent. There are also five copper stills for refining tar and tar oils which do not show well in the picture.

Lower Illustration—Charge of wood loaded on cars ready to be pushed into retorts. The building shown covers six ten cord oven retorts set two in a battery with necessary condensers, tanks, etc., to receive the crude distillate, also evaporating pans for acetate of lime and a hot floor on top of retort setting for drying acetate.

Storage tanks for finished tar and tar oils with water tower and power house in background. Power house has five one hundred and fifty h. p. boilers, pumps, lighting plants, etc.

tained. This is refined, usually by treating with a small amount of caustic soda and fractional distillation in a current of steam.

This process makes the highest grade of steam distilled wood turpentine and steam distilled pine oil, but has been entirely abandoned due to the impossibility of recovering enough product to pay expenses. It still remains, however, as the first part of the process in solvent plants where the chips, after treating as above outlined, are extracted with a solvent such as gasoline or benzol for the recovery of rosin.

There are a number of successful plants operating on this or similar plans.

The so-called Bath Process: In these plants the wood was loaded into cars, run into iron or concrete retorts and hot rosin or pitch was circulated by pumps through the retorts and heating system, thus vaporizing the turpentine and pine oil, which were collected by passing the vapors through water cooled condensers. In several plants of this kind the wood, after treatment as above, was subjected to destructive distillation to obtain tar and other products.

This plan made a good grade of turpentine and pine oil, but proved too expensive in practice and has been entirely abandoned.

The so-called Hot Air Process: In this system the wood was loaded in cars, run into retorts and heated slowly below its charring point and the vapors collected as in the other plants. A small amount of low grade rosin was drawn from the bottom of these retorts. The wood was sold as fuel or later treated by the destructive distillation process.

At present there are no plants using this process.

The Destructive Distillation Process: This is an outgrowth of the old pit and kiln process for making tar as referred to above, and consists essentially of a retort in which the wood is heated until it is completely charred, with a means of drawing pitch or tar from the bottom. A water cooled condenser in which the hot vapors are cooled to a liquid and a separating tank in which the oil and water thus formed are allowed to separate by gravity.

The developments in this process have been largely along the lines of improved retorts and the chemical refining of the oils obtained.

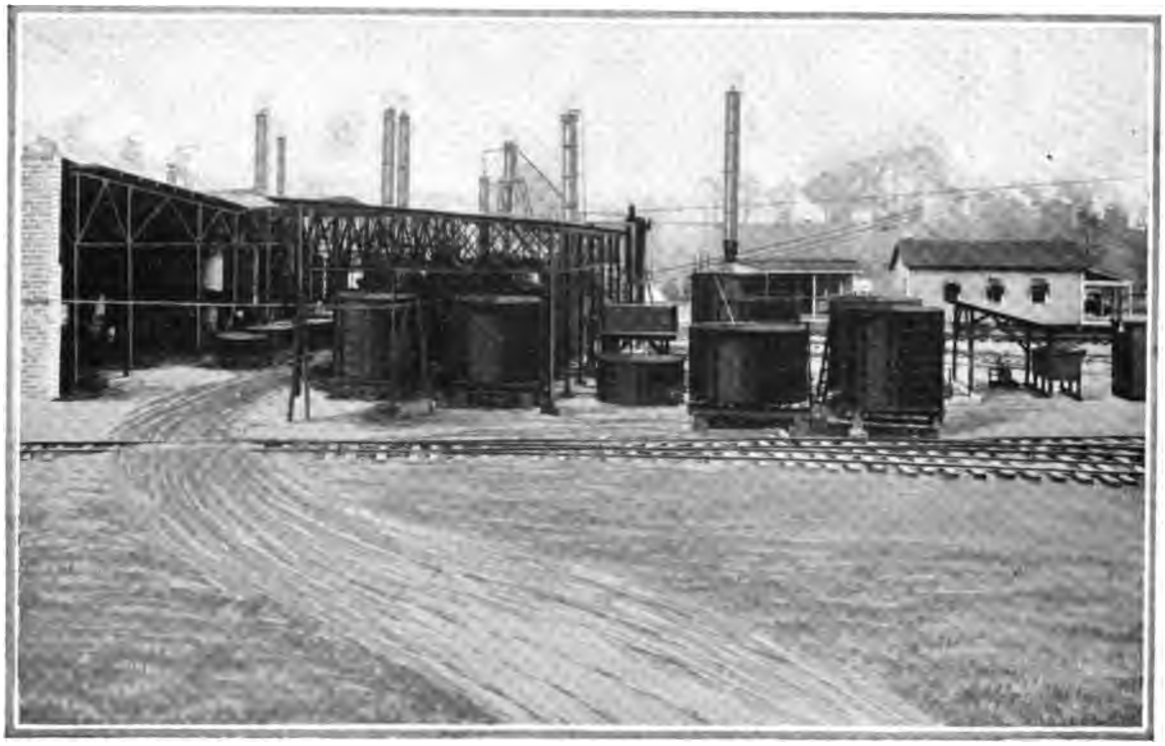
The retorts now used in the most successful plants are of three general types, the small cylindrical retorts holding from one to three cords of wood which are charged and discharged by hand. The large oven retorts holding about ten cords each and charged with cars loaded with wood, which are run in and allowed to remain until the wood is charred, then pulled into iron coolers where they are sealed up and the charcoal allowed to cool out of contact with air. In both of these types the retorts are heated with an external fire so arranged that the heat is distributed as uniformly as possible.

They may be fired with wood, coal or oil and the gas formed in the retort is usually led to the furnaces and burned. This type of retorts is nearly if not quite the same as those used in the hard wood distillation plants of Michigan, and is frequently called the Michigan oven.

The concrete retorts are built entirely of reinforced concrete and heated by iron pipes supported along the walls and carrying the hot gases from the furnaces. These retorts are charged with wood loaded on cars in the same manner as the iron oven retorts.

There are many variations of these three standard types, especially in the smaller plants, but all the large successful firms use retorts substantially as described.

The retorts are provided with copper, water cooled condensers into which the hot vapors from the wood are passed. The distillate, consisting of oil and pyroligneous acid, is led into wooden tanks and allowed to separate by gravity, then taken to the refinery for manufacture into the finished products. The oil, to produce pine tar, tar oils, pine oil, turpentine, and light solvent and the pyroligneous acid to yield wood alcohol and acetate of lime.



Another view of refinery showing stills and tanks used in manufacturing acetate of lime. Chemical laboratory in the background.

Besides the distillate drawn from the condensers there is usually more or less pitch drawn from the bottom of the retorts. This must be treated to produce the uniform grade which the market requires. It may be too soft when drawn, in which case it should be cooked over a direct fire to the proper consistency, or if too hard it may be tempered with soft pitch or tar.

It is packed in wooden barrels holding about one hundred and eighty pounds or in iron drums of about the same size and goes on the market as navy pitch. Some of the smaller plants have no refinery and carry the process only to this point.

The oil, when separated from the pyroligneous acid by gravity, is sold in this shape, either to other manufacturers to be refined or to the mining industry, where a considerable amount of this grade of oil is used in flotation.

In case other products are to be made a refinery, more or less elaborate, is provided. This consists of stills of iron or copper and in some cases of wood, provided with suitable water cooled condensers and heated with steam coils, steam jackets or by direct fire.

In some cases the stills are also provided with fractionating columns and in parts of the refining process this is very desirable. There are also a sufficient number of tanks of wood, iron or copper to hold the various grades of product and carry whatever finished stock is desired, and the necessary pumps for transferring the products.

A power plant is a necessary part of the equipment, consisting of steam boilers, water and fire pumps and lighting system.

In the refining process there are many variations depending on the equipment and products to be made. An outline of the process where the products are to be pine tar, pine oil, creosote oil, wood turpentine and light solvent will give a general idea of the operation.

The crude oil from the separating tanks is run into a copper still and distilled, either by heating with direct fire or with steam coils and live steam blown into the still, until the tar remaining in the still has the specific gravity desired.

The distillate is cut into two fractions, the first part carrying the light solvent, nearly all the turpentine and a little pine oil, and the second fraction carrying a little turpentine and nearly all the pine oil and creosote. The first fraction is treated with caustic soda and redistilled in a current of steam, preferably in a still with a fractionating column. The distillate is separated into three parts, first the light solvent, then the turpentine and lastly a small amount of pine oil.

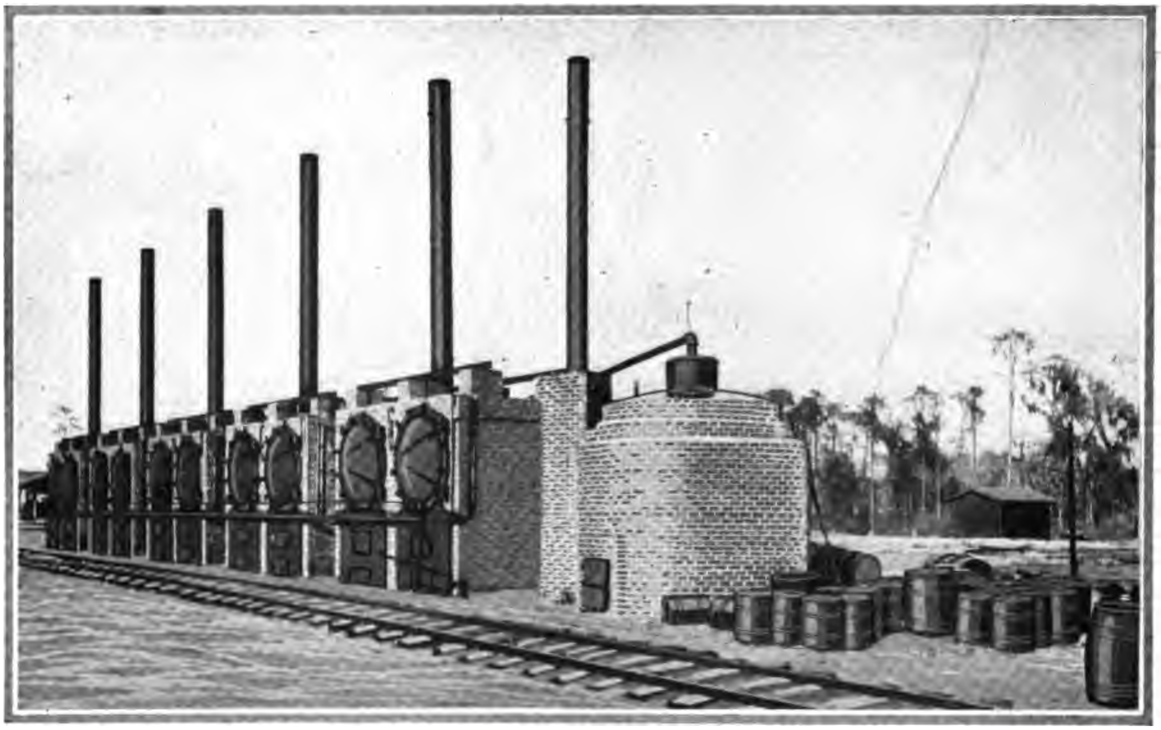
Each of these fractions may require further treatment with caustic soda and redistillation and the turpentine fraction is frequently treated with strong sulfuric acid to produce a water white turpentine.

The pine oil fraction is treated with caustic soda solution, and distilled either by direct fire or steam coils. In the latter case a current of live steam must also be introduced.

This treatment results in a small amount of oil which is returned to the turpentine fraction, pine oil, and a residue of tar. The caustic soda solution from the above may be treated with pyroligneous acid and the dissolved creosote oils recovered—or in case it is desired to produce medicinal wood creosote, sulfuric or carbonic acid is used in the recovery and the oil put through a complicated process of refining to produce wood creosote. U. S. P.

The market demands a number of grades of each of the above products which must be made to exact specifications as to specific gravity, boiling range, viscisity, color, etc.

Many plants discard the pyroligneous acid entirely or sell a small amount of it in the original form. It may be refined to produce wood alcohol and acetate of lime by a distillation to remove



Battery of ten one-cord retorts and one pitch still. Showing small steel barrels in which pitch is shipped.

tar, neutralizing the distillate with lime and again distilling, this time preferably in a column still, until no more alcohol comes over.

The residue in the still is run into tanks, allowed to settle, or filtered and evaporated until it becomes nearly solid, when it is removed from the evaporator and spread in a thin layer on a hot floor to dry. The dried product is commercial acetate of lime. The alcohol obtained above is treated with milk of lime allowed to settle and redistilled a number of times with lime and with chloride of lime and sulfuric acid until the finished product tests 95% alcohol or above, is colorless, free from bad odor and will mix in all proportions with water without becoming cloudy.

The manufacture of acetate of lime from pine wood should not be undertaken except under favorable conditions as to fuel supply, because, due to the lower contents of acid in pine distillates, it is difficult to compete with hard wood plants, either in price or quality of product.

The yield of saleable products from a cord of light wood varies so greatly, depending on the quality of the wood, the amount of wood considered a cord, and the method of handling, that it is almost impossible to estimate without knowing the exact conditions at the plant under consideration.

The cord unit has been abandoned by a number of operators and the wood handled on a ton basis. This would seem to be an extremely good plan as it eliminates the probability of getting much less than a cord in the ordinary measured cord of light wood.

A cord of rather poor wood might yield twenty-five to thirty-five gallons of crude oil, while a cord of extremely fat wood might yield one hundred and fifty to two hundred gallons of oil. The yield of charcoal should be thirty to fifty bushels per cord and of pyroligneous acid, one hundred and fifty to two hundred gallons. If refined, the pyroligneous acid should yield from one to two gallons of wood alcohol and thirty to fifty pounds of acetate of lime.

The crude oil when refined should yield sixty to seventy-five per cent. of tar, ten or fifteen per cent. refining loss and the balance creosote oils, turpentine, pine oil and light solvent, the turpentine yield running from five to twenty gallons per cord.

It would be impossible to mention all the uses to which these products are put, but a few of the most important are, the mining industry which takes a large amount of crude oil, creosote oil, pine oil and crude turpentine; the cordage manufacturers who use tar, tar oil, and special tars; the paint and varnish trade, which takes tar oils, pine oil and turpentine; the disinfectant manufacturer, who consumes pine oil and light solvent; the rubber industry, which uses tar and tar oils, and the ship chandlery trade, where large amounts of pitch tar and tar oils are required.

There is a demand at fair prices for all the products of this industry, but it is not a means of obtaining quick and easy money, as many have supposed, but requires the same careful design, operation and business management that is necessary to make any highly technical manufacturing enterprise a success.

The future of this line of business seems to be an assured one, as with the decline of the output of naval stores from the old sources, industry must depend more and more on wood products for their supplies, and the constant effort on the part of the manufacturer should in time make these products more satisfactory to the consumer than the standard naval stores have been in the past.

The development of this industry would seem to be still in its infancy and the next few years should see it take rank with the most important in the South.

WOOD ROSIN, STEAM DISTILLED TURPENTINE AND PINE OIL, THEIR CHARACTERISTICS AND USES.

(By R. C. Palmer.)

[Mr. R. C. Palmer has been for the past four years Chief Chemist for the wood turpentine plants of the Newport Company, at Pensacola, Fla., and Bay Minette, Alabama. Prior to that he was for six years Chemical Engineer at the U. S. Forest Products Laboratory at Madison, Wisconsin, where he was in charge of the wood distillation experimental work. The Newport Company plants have been unusually successful in working out the fundamental principles of this branch of wood utilization and have developed their process and products to a high degree.]

IN the purchase of new or even known products the manufacturer is frequently confronted with questions regarding their properties, characteristics and adaptability under varying treatments. Different users are often interested in entirely different properties of the same product, all other characters being entirely independent of the particular product manufactured. This often leads to confusion and suspicion especially where no effort is made to establish standards in all the important peculiarities of a commodity.

It was the natural thing for the industrial plant to first use the chemist with the purchasing end of its business to test the materials it had to buy, but usually left it to the customer to test its own product. If it did not "get by" it simply cut the price to satisfy the deficiencies or sold the product to another customer whose tests were not so rigid. This is no longer the accepted method. Now the manufacturer concentrates on his own product, studies its properties, endeavors to establish its proper method of use in all particulars, in short he standardizes his product, usually brands it and soon finds his standard commodity is accepted without question. In the central triangle of industrial work—Purchasing, Chemical and Selling—the latter two are fast becoming the most important.

In the early days of the wood turpentine industry there was no such thing as a standard product—wood turpentine was simply "Wood Turpentine." This was to be expected and is the case in any new industry which is begun with one idea and later develops on the basis of an entirely different one. The original idea was that of wood waste utilization with the hope to find a market for the products. As far as the steam and solvent process is concerned, with the decline of the gum turpentine industry becoming more and more apparent, at the present time the principal idea is the natural replacement of rosin and turpentine from that source with steam distilled wood turpentine and wood rosin. This transfer of the source of two such important products as turpentine and rosin cannot be done simply on the strength of the failing of the former supply. The idea that any kind of rosin and turpentine will eventually replace the present products cannot prevail with the present trend of highly specialized technical control in manufacturing plants. Only the most standardized products of equal or greater purity will last in the transition period. There are too many substitutes for both of these products already seeking to enter the market.

To the older school of "practical" men, a difference in a product often immediately stamped it in his mind as inferior, a substitute, whereas it is often the case that a difference may mean superiority—a new property of great importance, a fact which is now recognized by many of these same practical men. In view of these conditions the following survey of the physical characteristics, chemical properties and uses, of these products as now made with special reference to technical comparison between steam distilled wood turpentine and wood rosin and the older gum products, seems highly important at the present time. The importance of dissimilar properties in the uses of the products and to what extent the future may overcome any differences which may be classed as undesirable, will also be discussed.

STEAM DISTILLED WOOD TURPENTINE.

DEFINITION: Steam distilled Wood Turpentine is the pure oil of turpentine occurring in the dead or woody part of the pine tree. The term WOOD thus distinguishes it from the turpentine recovered from the limpid gum or oleo resin which will flow during the warm seasons from the live part or outer layers of the pine tree after it has been cut or wounded. Also, the term STEAM DISTILLED WOOD TURPENTINE at once describes the method of recovering the oil from the dead heart of the trunk or limbs. A high grade steam distilled wood turpentine and gum turpentine are essentially the same products insofar as they are both pure terpenes, but a careful examination shows that there are both physical and chemical differences between the turpentine from the two sources.

PHYSICAL CHARACTERISTICS: The most noticeable physical difference is in the odor. In the earlier days of the industry this difference was more marked and sometimes even objectionable, a circumstance which created a prejudice which took years to overcome. The high grade steam distilled turpentine which can now be found on the market can only be characterized as "different," as it is a mildly fragrant oil. Regarding this characteristic, it cannot be too strongly emphasized that the odor of a pure steam distilled wood turpentine is that of its principal chemical constituents, while the characteristic pungent odor of fresh gum turpentine is due to the presence of a very small amount of what is chemically known as an "aldehyde" which plays no part whatever in its various uses. Where odor is in no way objectionable and plays no part in its actual use, objections to this characteristic can only be related to the psychological or mental attitude of the user.

The color of high grade steam distilled wood turpentine is in general markedly superior to even the best gum spirits. It is uniformly water white and crystal clear. This is due to its final refinement which steams it entirely away from the presence of any resinous material. Gum spirits are always recovered directly from the rosin with the result that frequently resinous matter is carried over mechanically with the oil, causing varying degrees of discoloration and necessarily injuring the product for many uses.

The flash point of steam distilled wood turpentine is 34 to 36 degrees C. by open cup method.

The other physical properties of a pure wood turpentine, commonly referred to as the physical constants, such as specific gravity, index of refraction, boiling range, etc., are more closely related to its chemical composition and will be referred to under that head.

CHEMICAL CHARACTERISTICS: The principal constituents of all pure turpentines are definite chemical bodies called terpenes. American gum turpentine from the long-leafed pine is composed almost entirely of alpha and beta pinene. Nature produces a chemical change after the oils have stood in the dead wood for a long time and there appear in the turpentine other terpenes, the most important of which are called limonine, or its closely related counterpart dipentine, also terpinene

and perhaps cineol. Dipentine or limonine, is the chief of these and is a terpene whose source can be readily traced to the original pinene, but it has physical constants which give the turpentine from wood some of its chief characteristics. The amount of this body present varies somewhat with the source of the oil, viz., from dead heart wood, limbs, or the age of the stump or tree. It is sometimes not present in turpentine recovered from green saw mill waste but as the possible supply of turpentine from that source is very limited owing to the low yield and consequent high cost, it may be safely considered that the future turpentine from wood will always contain this substance. Dipentine is a terpene which has the ability to take up twice the amount of oxygen as pinene, so when wood turpentine is used as a thinner for paints and varnishes where its ability to dry —chemically speaking, to absorb oxygen—is of prime importance, the presence of this substance naturally gives a pure wood turpentine a marked advantage over gum spirits.

The presence of these other bodies besides the principal ones found in both wood and gum spirits give the wood turpentine its characteristic specific gravity and boiling range. The specific gravity of pinene, of which gum spirits is largely composed is about .8650 at 15 degrees C. and it boils at about 160 degrees Centigrade while the specific gravity of this other important constituent of wood spirits, dipentine, is .8480, and it boils at 176 degrees C. Thus a pure wood turpentine has a lower specific gravity and higher boiling range than gum spirits. That the presence of higher boiling oils in the wood turpentine is an advantage which is somewhat contrary to what might be supposed, is due to the fact that these higher boiling oils, although present in greater amounts than the high boiling material in gum spirits, are all drying oils and excellent solvents, while the high boiling material in gum rosin is chiefly resinous matter or oxidized terpenes which have lost their drying properties and are no longer good solvents.

Frequent attention is given by careful buyers to what is known as the sulphuric acid test for detecting mineral oil adulteration in turpentine. Using 38 N. acid with the proper temperature conditions the residue from this test is required by most specifications now in force to be less than 2% with a refractive index of over 1.500. This is correct for gum turpentine which is composed entirely of either pinene or its oxidized residues. However, it is well known by authorities on terpene chemistry that all terpenes are not acted upon in the same way by sulphuric acid. Pinene is completely destroyed by this acid but other terpenes of which dipentine and terpinene are examples, may be converted into still other terpenes by sulphuric acid. For this reason a residue so low as 2% cannot possibly be obtained when a pure wood turpentine is subjected to this test. The result will depend on the quantity of terpenes present other than pinene. As high as 3 to 4% residue with index below 1.500, but above 1.4925 may readily be obtained with a pure wood turpentine. These facts are now being recognized and merely further illustrate that wood turpentine is a distinctive product.

Specifications for pure steam distilled wood turpentine have not yet been drawn by either the Government Bureaus or the important Testing Associations, such as the American Society for Testing Materials. Up to the present time a pure wood turpentine has only been recognized by broadening the specifications for gum spirits with the idea of taking in wood turpentine. This is neither logical nor practical. A pure wood turpentine has its own characteristics which do not necessarily nor as a matter of fact, actually fall within the range of all the constants of a pure gum spirits. The day will soon come when wood turpentine will have its own specifications and stand on its characteristic properties as a pure body. The pure steam distilled wood turpentine that has up to the present time or can expect to entirely replace gum turpentine in every respect will have very nearly the following physical constants.

The specific gravity will range from .860 to .863 at 15 degrees C.

The index of refraction will range from 1.4668 to 1.4674 at 20 degrees C.

The boiling point will range from 150 to 153 degrees C.

The distillation range will be from 90 to 92% at 170 degrees C.

The sulphuric acid or polymerization residue using strictly 38 N. will be from 3 to 4% depending on the amount of terpenes other than pinene and the index of residue will be from 1.4925 to 1.4975 at 20 degrees C.

A turpentine having the characteristic odor of wood spirits which also falls within the range of all these constants is without question a pure turpentine.

Where the manufacture of a product is in complete control as is the case with wood turpentine, the production of an oil whose constants vary within such narrow limits is an easy matter. This is of great importance where the product is used in formula and in making mixtures where the weight volume relation is important as is often the case with turpentine, so an oil like wood turpentine with a practically constant specific gravity has a distinct advantage and recommends itself to the quality and quantity of the finished product.

USES: Wood turpentine of the high grades is now, with hardly an exception, used wherever gum spirits have been used. The majority of these uses relate to its action as a solvent for various gums, resins, etc., in the manufacture of a great variety of articles which range from shoe polishes to washing compounds, and as a volatile thinner for all manner of paints, varnishes, inks, etc. For the highest grade finishing work such as piano, cabinet, high-class automobile work, etc., the pure steam-distilled turpentine has readily found its place. Its advantages over gum turpentine as a thinner and drier have already been mentioned.

In the field of pharmaceuticals the merits of pure wood spirits turpentine have readily been recognized on account of the purity attained by the extra steam refinement to which it is subjected in its manufacture.

For producing secondary products such as camphor, terpinhydrate, and other products it will perhaps never compete with gum turpentine on account of its lower pinene content, but investigators have already recognized that the other constituents may have equally as great value in the manufacture of other important synthetic chemicals so even in this field the worth of the product will eventually depend on its own peculiar characteristics.

STEAM DISTILLED PINE OIL.

DEFINITION: The pine oil which in the last few years has become so generally known in the trade has no comparable product in the gum turpentine production. It is a product whose source is only in the dead heart pine wood, stump, limbs and knots. Older works on vegetable oils mention "pine oil" but the reference is generally to pine needle oils. Pine oil as now marketed is entirely a development of the wood turpentine industry. Every market which this remarkable oil now enjoys, which is now to the extent of hundreds of thousands of gallons yearly, has been the development of some particular property. It is doubtful if any commodity in the naval stores or allied industries, is sold for such a wide variety of entirely unrelated uses.

The origin of pine oil is not well established. Some of its constituents can be traced chemically to the original pinene in the turpentine. It is thought by some to occur in a different portion of the wood structure than the turpentine, but there is no proof of this fact. It was originally thought to be a product of the method of manufacture being produced by the action of steam on the other oils as they were drawn out of the wood in the first step of the steam and solvent process, but this has been entirely disproven. Pine oil is undoubtedly a product of nature's laboratory and occurs only in the pitchy portions of coniferous woods, chiefly the long-leafed pine. It is recovered along with the turpentine during the first stages of the steam distillation process and is subsequently readily separated from the turpentine on account of its widely different boiling range and subjected to final refinement with steam.

PHYSICAL CHARACTERISTICS: Steam distilled pine oil is a light, straw-colored oil. Its odor is extremely pleasant and is frequently described as like freshly cut pine wood, which is natural, since the odor of pine wood is undoubtedly due to the volatilization of the pine oil. The actual odor is a blended fragrance of the most predominating

odoriferous constituents of the oil, which will be mentioned later.

There are no standards for the physical constants of pine oil that are as widely accepted as those for turpentine, the demands of the trade governing this to a large extent. Several years ago the U. S. Navy issued specifications for pine oil, but they have not been generally regarded by the trade. Specifications for a commodity are usually first drawn to fit the largest requirements. Even this is difficult on account of the unrelated uses for the product. At the present time probably more pine oil is sold under the following constants than any other:

Specific gravity range from .9320 to .9350 at 15 degrees C.

Index of refraction range from 1.4798 to 1.4815 at 20 degrees C.

Boiling point range from 190 to 195 degrees C.

A distillation range of from 85 to 90 per cent. between 190 and 218 degrees C.

An acidity of less than .1 of 1%.

A free water content of less than 1¼%.

A polymerization residue of less than 5% with index above 1.4850, using U. S. Navy method for turpentine.

A comparison of the specific gravity and index of refraction is usually a sufficient guarantee of purity and freedom from adulteration, taking into consideration that the minimum index usually corresponds to minimum gravity. It is possible to lower the gravity of a pure pine oil and raise the index above the minimum that indicates purity, by completely removing the free water but it is not possible to lower the index by physical means other than adulteration. The sulphuric acid residue is, of course, always a final test for mineral oil.

Some of the constituents of pine oil are what are known chemically as hydrated bodies and will not give off their water unless heated to a temperature above the boiling point of water. The water obtained by dry distillation of pine oil is, therefore, a measure of both free and combined water. The free water in pine oil may be measured by extreme dilution (5 to 1) of the oil with a petroleum naphtha and collecting the precipitated water. When gravity and boiling range are particularly specified the purchaser usually has in mind some particular constituent of the oil. The pure oils of higher gravity and boiling range naturally command the best price.

The flash point of pure steam distilled pine oil of average gravity .9330 is 76 degrees C. by open cup method.

Probably the most interesting properties of pure steam distilled pine oil relate to its physiological action. It is a highly antiseptic oil with a phenol coefficient of 4½ to 5 as determined by the U. S. Public Health Service and in addition it is markedly anaesthetic, 1 c. c. being equivalent to 1-5 gram cocain as a local anaesthetic. In addition it has the peculiar property of stimulating tissue growth, which is a most unusual property for any substance which is also anaesthetic in its action. A number of uses are based upon these properties.

CHEMICAL CHARACTERISTICS: The constituents of a pure steam distilled pine oil as has been mentioned, can in some cases be traced to the original terpene, pinene, others can be traced to what may be intermediate stages, viz., the dipentine, terpinene, etc., which comprise the other constituents of wood turpentine. All the constituents fall under the general class of terpenes and the important ones in the order of their predominance are terpineol, fenchyl-alcohol, borneol, cineol, dipentine, camphene, terpinene and phenols. It will be observed that traces of the higher boiling constituents of wood turpentine, dipentine and terpinene, are found in the pine oil, which is to be expected. The borneol is probably the source of the predominating odor giving it its camphor like sensations on deep inhalation of the cold vapors.

The phenols are probably the source of the color of the oil since redistillation over caustic will give a water white product.

It is not yet known what constituents give the oil its remarkable antiseptic and anaesthetic properties.

USES: The uses of pure steam distilled pine oil range from the mines of the far west to the mosquito swamp of the south and east Atlantic Coast. The largest general uses may be grouped under the following heads: First, the mining industry; second, the paint and varnish industry; third, in the manufacture of disinfectants, sanitary deodorants and germicides; fourth, the essential oil industry; fifth, as a solvent for a variety of materials; sixth, as a denaturant for alcohol.

With the exception of the much more costly eucalyptus oil no other oil has been found as generally valuable either alone or in combination with other oils, as steam distilled pine oil, in the recovery of metals by the "flotation" process.

Steam distilled pine oil is a slow drying oil, but dries to a hard glossy finish. As a solvent for gums, resins, etc., the solvent properties of steam distilled pine oil are not surpassed by any of the natural oils. It is, therefore, readily used in the manufacture of paints, varnishes, lacquers, japans and enamels, as superior to other more expensive oils. The deodorant properties were at once recognized as of value in the manufacture of mineral oil paints and varnishes and in addition serve to materially improve the working qualities of the product. The regeneration of rubber, the production of plastics and as the basis of metal and furniture polishes, are among its wide applications as a solvent.

The germicidal properties of this oil, which have already been mentioned, have promoted the development of a wide use in the manufacture of antiseptics, emulsions, insecticides, liniments, healing salves for wounds, burns, ulcers, etc., mosquito repellants, and many others too numerous to mention, for which it is put up under various proprietary names. The fact that the oil is non-poisonous and will not irritate the skin greatly adds to its superiority over the many coal tar compounds, also sold for the same purpose.

Some of the constituents of the pure steam distilled pine oil when isolated by chemical means, are extremely valuable essential oils which are in demand in the manufacture of perfumes, fine soaps and various toilet preparations. It is interesting to note that for the manufacture of terpinhydrate and related products, whose chief source has been gum turpentine, pine oil has already proven itself a more economical raw material, thus supplying a source of these substances which wood turpentine would fail to do.

The distinctive properties of steam distilled pine oil have lately recommended its use as a denaturant for grain alcohol, a use which will undoubtedly develop into a very large one.

Pure steam distilled pine oil fully bears out its reputation as a unique product which a few years ago was not only unknown but its uses completely undeveloped. Today the production cannot supply the demand and new uses are constantly being found.

WOOD ROSIN.

DEFINITION: Wood rosin is the term used to distinguish the rosin which may be recovered from the dead heart of the stump, limbs or trunks, of the pine tree, from the gum rosin recovered from the gum which will flow from the live outer layers of the live tree.

It could not be expected that this rosin would remain identical with the product of the living tree. The changes in any product where the natural forces play the part of the chemist, cannot always be understood but they can invariably be expected. In this instance we have occurring in the dead pitchy wood, a rosin which is as distinctive a product as wood turpentine. It should be the policy of wood rosin producers to recognize this product on the merits of its own characteristic properties, and to fully establish the application of these features to its various uses. This viewpoint is now rapidly being taken, as it becomes more and more apparent that wood rosin must replace the gum product. In the early days many attempts were made by unscrupulous salesmen to market wood rosin as gum. The customer was seldom deceived and the fallacy of that method is apparent.

The fact that wood rosin may have its own characteristics in no way implies any degree of inferiority, but may actually, as will be noted, mean a better product in certain instances.

Because of the complexity of rosin from a chemical standpoint, the development of this product has been much slower than the turpentine and pine oil recovered from wood by the steam and solvent process. This was due to the fact that the oils were readily obtained and refined while much effort was expended in securing a satisfactory solu-

tion of the problem of extraction considering both yield and quality of product. Further improvements along the line of increased production will yet be made, although these will probably be only along the line of securing better contact between rosin and solvent as the solvent feature of the process seems well established.

PHYSICAL CHARACTERISTICS: In the first place the producer of wood rosin has an advantage in the control of quality which could never be approached in the gum rosin industry and this feature results in the outstanding physical characteristics of this product—its uniformity in all particulars. It is not possible to too strongly emphasize the importance of this in marketing the rosin. It is safe to say that no raw material sold in the chemical markets of the country has such a wide variation in its important physical and chemical characteristics, which for the most part are not even known, as gum rosin. We have in this commodity a condition without parallel—a material with distinct chemical properties which have a wide application but sold on the basis of its color as the only specification.

Wood rosin, or an extracted rosin, is by virtue of the process of recovery, a perfectly clean rosin and is never found full of dirt, sand, twigs, chips, etc., as is sometimes the case with gum rosins which have been strained through crude and often imperfect batting filters, a common characteristic of the darker grades. This physical property of cleanliness is a very important one from an economical standpoint. A barrel of wood rosin of any standard brand means a full barrel of usable rosin.

The color of the wood rosin now on the market is a bright reddish tint of exceedingly great clearness and its grade as measured by the standards of the New York Board of Trade is gauged as E to F, being full F in brightness, but slightly less in tint because of its peculiar reddish cast. This color characteristic is due to a combination of several things, a trace of metallic substance picked up during the process which is also now frequently the case with the lower grade gum rosins, since the metallic cup has become so widely used, and to a trace of pigment whose source has until recently been obscure. Both the metallic salts and pigments, unfortunately, also show in many cases the same chemical characteristics as the rosin itself and the color thus limits the use of wood rosin to all purposes where coloring matter is not objectionable in the finished product.

Wood rosin has a characteristic odor due chiefly to the conditions to which it has been subjected in standing in the heart of the stump. During the early development period of wood rosin the removal of the last traces of the solvent was not well understood, and when heated the rosin indicated improper finishing, but the standard brands now on the market are dry and sweet, suggesting sugar in stages of caramelization and the odor is in no way objectionable.

An important physical characteristic of rosin which should be of interest to many users is its melting point. Here again uniformity, due to ability to control the method of manufacture, gives wood rosin a marked advantage over gum rosin, although the extracted product melts at a slightly lower temperature than the average gum rosin. When rosin is melted to a liquid condition prior to subsequent treatments such as solution or soaping, a slightly lower melting point is naturally not disadvantageous. Only when rosin has to be retained in a powdered condition for a long period under above normal room conditions or where it enters into a plastic which is later required to withstand unusually high temperatures, is this property detrimental. The cause of the lower melting point is the presence of a small amount of material which appears to be in the transition stage between oil and resin and is an extremely resinous substance of such high boiling point that it cannot be separated from the resin by distillation. It can be oxidized to a hard resin, but not without greatly darkening the rosin itself. It is doubtful if wood rosins of the lower grades can ever be produced which will melt much above 56 degrees C., compared to the average of 62 degrees C. for gum rosins. The normal melting point (in reality fusion point as determined by the common capillary tube method) of standard wood rosin now on the market is from 53 degrees C. to 55 degrees C. Compare this uniformity with gum rosins, whose melting points vary from 50 to 70 degrees C.

Any disadvantages caused by the peculiar feature which makes the wood rosin melt at a lower temperature are largely offset by the fact that it also imparts to the rosin a remarkable toughness. This property is of great value in the manufacture of all materials where rosin is used as a binder, which is a feature of special superiority over the gum product. When properly finished wood rosin has a lower melting point than gum, but on the other hand its ability to fracture is not impaired and it is not tacky, but tough.

CHEMICAL CHARACTERISTICS: The important chemical characteristics of a rosin relate to its ability to combine with the metallic elements of the alkalies to form soaps, to the products yielded by destructive distillation and its solubility in various solvents.

The measure of the ability of a rosin to combine with alkalies to form soaps is usually referred to as its saponification number. Actually it is the number of milligrams of potassium that will combine with 1 gram of rosin. The saponification number of wood rosin of E-F grade is an extremely constant figure of from 158-160, compared to the same constant for gum rosin which varies from 155 to 175. On an average the wood rosin presents a lower value. This is an example of the changes due largely to oxidation effects in the older rosin. Here again uniformity and the ability of wood rosin producer to sell his product on a guaranteed value, gives the wood product a distinct advantage. It is unusual if a soap maker, for instance, would not appreciate the advantage of knowing beforehand the saponification number of his rosin and could reasonably expect all shipments would be practically identical. The amount of unsaponification matter in wood rosin is low—less than 5%—while many gum rosins have a much higher figure. The importance of this is readily seen.

The products of destructive distillation of wood rosin differ very little from those from gum rosin. The yields are fully as great but the proportions of the different fractions are somewhat different. Much less naphtha is obtained from the wood product, while the yields of the principal oils, as well as the pitch, are generally higher. On account of the slightly lower neutralization value the amount of oil suitable for grease making is likely to be somewhat lower, but in general as a source of rosin oils, wood rosin presents no difficulties when its characteristics are properly understood and the destructive distillation conducted accordingly.

The solubility of wood rosin is one of its outstanding characteristics and is unfortunately one that is detrimental to its use in some instances. Rosin is composed chiefly of what is called abietic acid, an extremely complex substance which as far as it is understood may exist in several, what are known chemically as isomeric forms, with slightly different properties. The evidence at hand now seems to indicate that the abietic acid in wood rosin is an isomeric form of the same body in gum rosin, one indication of which is seen in its lower solubility in such solvents as benzol, petroleum naphtha, alcohol, etc. This is overcome largely by the addition of vegetable oils such as pine oil, china wood oil, in which the rosin is much more readily dissolved. Where solvents of relatively high boiling point are used, as for example, linseed oil, the long application of dry heat greatly aids the solution. The addition of a small amount of lime is also of value in improving solubility of wood rosin.

USES: The uses for wood rosin are extremely varied and are in general the same as those for the gum product. The most extensive of these comes under the head of soaps, which includes all soaps using rosin where the color of the finished product is not important. This comprises the size for newsprint, paper board, wrapping and hanging papers, laundry soaps, waterproofing compounds, emulsifiable oils for disinfectants, lubricants, leather dressing, shoe polishes and many others. Wherever the soaping qualities of wood rosin have been fully understood and the ease of soaping and uniformity and cleanness considered, this rosin is now preferred to the gum product.

The next most important use is in the manufacture of plastics and binders, foundry work of all kinds, including pattern compositions and casting cores, linoleum and oil cloth, papier-mache and sealing waxes, are included in this list. The superior toughness of wood rosin already referred to, especially recommends its use in this field.

For the manufacture of rosin oils and the great number of uses for such products, as printing inks of the dark colors, greases and lubricants, wood rosin has a large use, where its characteristics are fully understood.

For the paint and varnish and allied industries, such as gloss oil, paint compounds, low grade varnishes, the use of wood rosin is limited on account of the relative lower solubility, but it is frequently the case that the user will specify the wood product on account of its other quality of cleanness, ease of working, etc., and will admix the desired amount of vegetable oils or other chemicals, to satisfactorily secure the desired consistency.

Increased uses where color is of prime importance can only come as a result of improvements in the quality of wood rosin and this in turn can only result after a fuller understanding of the chemical composition of the product. Some producers have already been making an intensive study of this feature. The natural color of the rosin in the dead wood ranges from G to H, depending on the age and locality of the raw material. The recovery of a high grade wood rosin has already been successfully solved by at least one leading producer and should be on the market within the next eighteen months. Further improvements in color are still in the laboratory stages of development, but it has already been demonstrated that rosin of any desired color and degree of purity may be produced from wood.

The future presents unlimited opportunity and the consumer who has doubted that wood rosin can ever completely replace the gum product can rest assured that when conditions warrant, the replacement will not only be complete but as a result of chemical manufacture he will have at his disposal a more uniform and superior product than was ever produced from the living tree. Such a broad statement may appear to some as extremely visionary. The prediction is, however, based entirely on facts already realized or obviously apparent.

THE ADVENT OF WOOD DISTILLATION AND MARKETING OF THE PRODUCTS

(By L. Wilson.)

[Mr. L. Wilson is president of The United Naval Stores Company, of New York City. As the active manager of its business he has made a thorough analytical study of wood products, their uses and markets, and has become recognized as an authority along such lines. Handling large quantities of all of such commodities his efforts have been incessantly toward the stabilizing of the products of wood distillation plants and the creation of permanent and expanding markets for them.]

Wood Turpentine
Steam Distilled
Wood Turpentine
Destructively Distilled
Pine Oil
Steam Distilled
Pine Oil
Destructively Distilled
Wood Rosin
Pine Tar
Pine Tar Oil
Pitch
Charcoal

Stages Passed Through By the Wood Distilling Industry.

THE IDEA AND THE PIONEER: Manufacturing naval stores from waste wood that will eventually replace the supplies obtained from the Southern pine forests which are fast diminishing was a great idea. However, when the pioneer had to face the practical the trouble commenced. The trade is always reluctant and slow to take up new things. In this case it was no exception. When the consumer was induced to experiment and found the materials useful, new troubles had to be contended with, especially inability to make the same products twice alike. Needless to say that different plants produced different products. Besides, most of the pioneers, and they were very few, had very little more than their ideas and a great ambition. However, no sooner one gave up, than another, with greater confidence, took his place, each successive one thinking that his new kink would do the trick.

In spite of continued disappointments, new ones could only see a promising future and kept on building on the ashes of their predecessors.

The persistence and constant hammering gradually had its effect and the industry began to take permanent and profitable shape. Simpler methods were eventually adopted as basic principles. More of the practical and conservative began to be felt in the trade, and the supply really commenced to create demand.

The various methods eventually developed into two basic processes:

(1) The Destructive Process, wherein the light wood is placed in iron retorts with direct heat applied, forcing the crude over through condensors, the product thereafter fractionated into standard products of Wood Turpentine, Pine Tar, Pine Oil, Pine Tar Oil, Pyroligneous Acid, and in some instances, Special Light Oil and Pitch Residuum. By this process the wood fibre is destroyed and turned into Charcoal.

(2) The Steam or Solvent Process, wherein the wood is hogged into chips, placed in condensors covered by solvents to soften and help release the resin from the fibre, producing Turpentine and Pine Oil, which are driven off by steam and the Rosin drawn off. There are several slight variations in this process.

In the products obtained by the last named process, the Turpentine is very mild in odor and matches closely the gum product, and is consequently easier to market. The Pine Oil is very sweet in odor and the Rosin which is produced in grades "D," "E" and "F" is closely similar to the same grades of Gum Rosin.

These advantages are, however, offset by the high first cost of installation. Such a plant is also expensive to operate as compared with the Destructive Process, which really retarded development of the Steam Process.

Considerable Quantities Standardized Products Regularly Made, Extensively Used at Home and Abroad in Representative Industries.

WOOD TURPENTINE is very extensively used along the same lines as Gum Turpentine; in fact, it is included in the Government specifications.

WOOD ROSIN is used in the manufacture of linoleum, printing inks, core oils, dark paper, dark varnishes; in fact, with few exceptions, for all purposes that dark Gum Rosin is used.

PINE TAR is used in the manufacture of cordage, oakum, water proofing and various other lines where binding, deodorizing and preserving qualities are required, or high boiling point is a feature.

PINE OIL, premier flotation oil used in the mining industry for the recovery of precious metals, in the manufacture of paint and varnish, in the manufacture of a high co-efficient disinfectant (Government formula), also for medicinal preparations, it is a powerful solvent and deodorizer.

PINE TAR OIL, closely akin to Pine Oil, is also used in the manufacture of ship bottom paints, in preservatives, insecticides.

PITCH is used for caulking boats, waterproofing, electrical insulations, paint preparations.

CHARCOAL is used in the manufacture of charcoal steel, also for home use.

Wonderful headway has been made towards a universal use of Wood Products in the last few years, which is highly gratifying, but there is still room for improvement. (See footnote.)

The fact that thousands of dollars have been expended and lost in the incubation of this industry has been due, in our opinion, to three main causes, any one of which in itself would account for failure: First, the lack of practical scientific engineers experienced in this or analagous fields, and second, financing for the sale of stocks and securities rather than product, and third, lack of sufficient marketing organization. It must also be borne in mind that owing to the number of different processes there was caused a lack of uniformity of products which naturally tended to increase selling cost. * * * The manufacturing of wood turpentine necessarily will become of far reaching importance in the future. This is for the reason that it is utilizing an absolutely waste product and is at the same time clearing cut-over lands and rendering them fit for occupancy. We wish also to emphasize the statement already made that many past failures were due to the unreasonable speculative condition of the markets. Abnormally high prices of naval stores induced promoters and unscrupulous persons to capitalize their concerns on the earning capacity during this period, thereby making them "stock jobbing" propositions rather than legitimate manufacturing institutions. This kind of financing while apparently expanding the industry, really retarded development, as the energies of the management were expended primarily in the office and at the expense of the manufacturing organization.—From paper by E. H. French, Consulting Chemical Engineer, and James R. Withrow, Professor of Industrial Chemistry of the Ohio State University, 1914.

Suggested Lines of Improvements That Would Make for Economy and Easier Marketing.

POSSIBLE IMPROVEMENTS IN THE STEAM PROCESS: All producers may make their Turpentine to conform to Government specifications. Some are doing it. Make the Rosin harder—eliminate the viscous matter from the Rosin. Lighter grades could and should be made, probably as light as "H." Laboratory experiments should be carried on with a view to making it adaptable for soap making and to overcome its tendencies to darken when fused with lime in varnish manufacture. Eliminate the mineral oil content from some of the Pine Oil. Technical improvements in the extraction. Greater recovery of solvent. Means should be found to utilize the extracted chips for paper pulp or other suitable by-products, or for any purposes more valuable than fuel. (See pages 64-65, Special Agent's Series No. 110, By-Products of the Lumber Industry, Department of Commerce.)

POSSIBLE IMPROVEMENTS IN THE DESTRUCTIVE PROCESS: While the Government issued specifications on Turpentine, Pine Tar, Pine Tar Oil and Pine Oil, some of them leave too much room for variations which is not satisfactory for general trade requirements, and besides, hardly any of the producers follow all the Government specifications on all of their products. Although, in a general way, the more prominent producers are making fairly standardized products that are acceptable to the trade in general, the greatest trouble is caused by the continuous crop of pioneers who, instead of following along the accepted lines are improvising all kinds of apparatus, and offer in the market their crude extractions under standard names, resulting in disappointments which create suspicion among consumers, making them distrust everybody. While they are entitled to and have a perfect right to follow up their experiments and also to dispose of their material which they can readily do, however, for the protection of the others and for the good of the entire industry, specifications should be adopted by either trade bodies or Government ruling so that such products cannot be misrepresented or misunderstood.

Specifications Along the Following Lines Would Probably Cover the Situation and Help the Marketing Very Much.

Turpentine can and should be made to conform to Government specifications, although the specific gravity limit could be shortened to advantage from .862 to .868 at 60 degrees F. instead of .862 to .872. For painting purposes, Wood Turpentine specific gravity of .872 dries too slowly.

Conforming Pine Oil to Government specifications would be all right, especially in the main point, "should be of a light straw color with a specific gravity between 0.937 and 0.933 at 60 degrees F." Probably between 0.940 and 0.930 would do very well.

Pine Tar Oil. Government specifications call for specific gravity between 1.07 and 1.02 at 60 degrees F. It only requires that 80% of the distillate should come over at 700 degrees F., which is apparently not sufficient safeguard, because many use it as a high boiling oil and if they should receive a crude of a gravity of 1.02 with Turpentine and Light Oil in it, it would turn out very unsatisfactory. Besides, the trade as a rule expects Pine Tar Oil to be of a specific gravity of about 1.03 with the Turpentine and Light Oil eliminated; consequently, a specific gravity of between 1.02 and 1.04 would be about right.

Pine Tar. Government specifications call for a specific gravity at 60 degrees F. not greater than 1.1. The next requirement is that not more than 20% should be light oils of a specific gravity of about 0.95, and that not less than 67% to be heavy oils of a gravity of about 1.05. While the last safeguard is all right, eliminating the crude, however, the trade as a rule is not satisfied with the extreme limit of the specific gravity of 1.1. The most acceptable to them as a rule is a specific gravity of about 1.07,—between 1.05 and 1.09 would be best. Free water should be eliminated,—only a certain small percentage allowed.

The idea is that products conforming to the above mentioned specifications could be sold by their names without any further description. Any of the variations should be offered by samples or by proper description. Daily or weekly quotations with statistical figures would no doubt help.

Pyroligneous Acid, not at present utilized, but can and should be in the manufacture of Acetate of Lime, or to find proper means to concentrate it.

Avoiding direct fire to bottom of retorts would very likely eliminate considerable expense and the troublesome feature of keeping them in repair. The method now used by some is the retort resting on the apex of a brick arch with windows on either side of the arch, drawing the fire more towards the sides of the masonry work and indirectly striking the sides of the retort on rebound.

The method of drawing out the Tar from the bottom of the retort, allowing only the light oils to come over through the condensors, with pipe at the end of condensors and under the fire place, to take care of the non-condensible gas and burn under retort, saving some fuel, is worth while considering.

The use of iron baskets for loading and unloading retorts is worth while accepting by those who don't use it, as a matter of economy.

With the wood supplies getting away further and further from the plants all the time, it is well to be considered that future buildings of plants should be closer to the wood supplies, with an eye on freight rates of finished products at the same time.

Plants should be semi-portable as far as possible. Even though it is further away from the shipping port, the saving freight on the wood will offset the extra freight on finished products to the port for eastern shipments by boat. For inter-southern shipments or shipments north and west, it will show a clear saving.

There are millions of acres of waste cut-over land; the time is ripe for conservative capital to go in. Millions of acres of cut-over land suitable for agriculture may gradually be cleared and utilized right on the ground in accordance with suggestions., Besides getting the supply of wood at low price, the value of the cleared land is enhanced several times while it solves the great problem of clearing cut-over land for agriculture. Farm land is growing scarcer all the time. It has advanced enormously in the last few years.

PROGRESSIVE FURTHER DEVELOPMENT: While there is room for additional plants for the Destructive Process, nevertheless, it must move gradually while developing the outlet for most of the products. On the other hand, the opportunity of placing unlimited quantities of the products of the Steam Process is much greater; in fact, it is almost unlimited, simply replacing the diminishing supply of Gum Rosin and Turpentine, and the development on a large scale must take place mainly along that line.

Owners of tracts of cut-over land suitable for agriculture who are interested in clearing along above lines, should be assisted in every way possible.

Increased farming acreage will help to lower the cost of living and should be encouraged by all.

LONDON AS A ROSIN MARKET

(By Charles Moore, of Moore & Hole, Naval Stores Dealers, London, England.)

[Mr. Charles Moore is the managing partner of Moore & Hole, for more than a quarter of a century a well known London naval stores house, in which his father and the late E. Nelson Hole were for many years active spirits.]

THE rosin trade we consider to be a most interesting one, although possibly not so "spectacular" as turpentine, but considerably larger in its volume of actual consumption.

Rosin is so engrossing because it plays a part in the manufacture of so many articles with which one comes daily into touch, such as soap, paper, linoleum, varnish, boot polish, printing ink, sealing wax and several other compositions.

The article is imported from America by sundry firms in London, and of course the outports, and sold to the numerous consumers, either ex-ship on C. I. F. terms, or ex-wharf. Until the Government control, which became necessary during the Great War, the article was subject to 2½ per cent discount on ex-wharf terms, but since that time all prices have become strictly net. Grades most sought after are:

B-C, known as Common Strained.

F-G, known as Medium.

N., W.G., and W.W., known as three tops.

The uses of rosin are so widespread that they place one in touch with valuable and interesting clients practically all over the world.

There is quite a big competition now against American varieties from both France and Spain, more particularly in the better, or paler qualities, although during the last year or so France has become quite a powerful rival in F-G grades, both for home consumption and also for export. The terms on which these rosins are sold differ in one or two respects only from those of American, the allowance for tare being only 7 per cent. (in casks about 3 to the ton net) against 20 per cent. on American (in barrels 6 to the ton net).

Just to show the wonderful advance there has been in the consumption, a glance at the extraordinary increase in the value of the article is sufficient, for whereas, say 25 to 30 years ago it was quite an easy matter to buy at £3, 10s. to £5 per ton, according to quality, we have seen up to £70 to £75 per ton freely paid in the interim.

A return of the imports of rosin unto the undermentioned ports in the United Kingdom, consigned from the United States of America and all other countries during each of the years 1914 to 1919 inclusive:

PORTS OF IMPORTATION	IN CWTS., OF 112 LBS., 20 CWTS. TO TON.											
	1914		1915		1916		1917		1918		1919	
	U S.	Other	U S.	Other	U S.	Other	U S.	Other	U S.	Other	U S.	Other
London (inc. Queenborough)	448,341	174,784	212,077	380,509	351,555	214,665	130,191	124,834	8,337	37,042	207,369	167,518
Liverpool	311,063	198,584	461,958	430,547	914,490	131,490	903,355	150,686	266,117	143 139	727,828	283,263
Hull	27,156	15,697	21,653	2,452	31,756	2,040	63,107	9,056	8,347	3,060	5,311	8,176
Bristol	53,414	16,835	33,118	31,980	69,454	63,998	15,034	45,659	21,281	43,649	19,865	36,593
Manchester	80,617	5,520	82,683	9,510	9,095	3,817	37,562	3,221	10,913	11,827	20,841	45,963
Newcastle	15,753	4,070	....	1,440	....	....	....	....	....	....	....	381
Cardiff	....	....	....	....	....	....	5,907	....	....	119,204	....	20
Glasgow	95,486	32,798	99,216	128,096	110,993	70,676	133,188	84,387	30,213	26,911	107,915	115,350
Belfast	5,278	....	919	....	....	....	....	....	....	....	2,962	273
Dublin	5,996	130	800	....	....	....	....	....	....	....	....	....

IMPORTS OF ROSIN INTO THE UNITED KINGDOM FROM ALL SOURCES, IN TONS OF 2,240 LBS., OR 1,016 KILOS.

FROM	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920
United States	58,425	66,034	66,295	55,989	50,310	48,381	50,089	50,763	66,651	53,907	52,931	75,745	65,114	18,275	57,240	31,283
France	17,902	11,793	11,780	19,056	14,610	16,987	13,250	17,742	9,672	16,182	37,856	14.580	14,864	15,806	21,366	22,507
Spain-Portugal	3,429	3,816	4,607	6,440	5,298	8,160	8,644	10 091	8,350	6,224	10,579	9,550	6,350	3 378	9,617	4,860
All Other	775	884	126	641	781	1,503	2,288	3,473	3,230	1,090	1,047	215	....	162	798	1,825
Totals	80,531	82,536	82,808	82,126	70,999	75,031	74,271	82,069	87,903	77,403	102,413	100,090	86,328	37,621	89,021	60,475

(The statistics used in these London articles were compiled from the annual reports of Mr. James [illegible] and from the British Government records.)

AVERAGE MONTHLY QUOTATIONS OF STRAINED ROSIN AT LONDON, ENGLAND, PRICES PER CWT. (112 LBS.) OR 50¾ KILOS, EX-WHARF.

MONTH.	1906	1907	1908	1909	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919
January	9s 7½d	10s 6d	9s 6d	8s 3d	10s 4½d	15s 9d	17s 1½d	14s 7½d	9s11d	11s 1½d	22s 3½d	26s 9d	65s 1½d	55s—d
February	9s 6d	10s 9d	9s 7½d	8s 4½d	10s 9d	17s 3d	16s 9d	15s10d	10s—d	11s 8d	22s 3d	29s 9d	65s 6d	45s—d
March	9s 9d	10s10½d	9s 6d	7s10½d	10s 7½d	18s 9d	16s 9d	14s 3d	9s 9d	11s 3½d	21s 4d	32s 4d	64s 6d	40s—d
April	9s 9d	10s10½d	9s 6d	8s—d	10s 9d	19s 3d	17s—d	12s 8d	9s 6½d	12s -d	21s 3d	32s 9d	64s 6d	36s 9d
May	10s 1½d	11s—d	8s 4½d	8s 1½d	11s—d	17s 3d	16s 6d	11s 9d	9s 6d	12s 8d	21s—d	32s 9d	63s—d	35s—d
June	10s 1½d	10s10½d	7s10½d	7s 9d	12s—d	16s—d	16s 6d	11s11½d	9s 5½d	12s 2d	21s 3d	32s 9d	62s 7½d	38s 3d
July	9s 9d	10s 7½d	7s10½d	8s—d	14s—d	14s 6d	15s10½d	10s11d	9s 3½d	12s 2d	21s—d	32s 6d	60s—d	38s 6d
August	10s—d	10s 6d	7s 4½d	8s 4½d	14s 6d	14s 7½d	16s 5d	10s 6d	11s—d	11s 9½d	21s 3d	31s 8d	60s—d	41s 1d
September	10s 3d	10s 6d	7s 1½d	9s 4½d	14s 9d	15s 6d	16s 6d	10s 3½d	9s 6½d	12s 2d	21s 6d	33s—d	55s—d	48s—d
October	10s 4½d	10s 3d	7s 4½d	10s 2d	15s 1d	15s 6d	16s 4½d	9s 4½d	8s 2½d	13s11½d	21s 6d	34s11d	55s—d	50s—d
November	10s 4½d	9s 9d	7s 9d	10s 1½d	14s 9d	15s 4½d	15s 9d	9s 7½d	8s 7½d	18s 3½d	21s 9d	46s 6d	55s—d	50s—d
December	10s 3d	8s 9d	8s 3d	10s—d	14s 8d	16s 1½d	15s 2d	9s 9d	9s 4d	21s 6d	24s 5d	60s 6d	55s—d	50s—d
Yearly Avg.	10s—d	10s 5d	8s 4d	8s 8d	12s 9d	16s 4d	16s 6d	11s 9d	9s 6d	13s 5d	21s 9d	35s 6d	60s 5d	43s11d

IMPORTS OF ROSINS INTO THE UNITED KINGDOM FOR CALENDAR YEARS, IN TONS OF 20 CWTS, 2,240 LBS., OR 1,016 KILOS.

Year.	Tons.
1870	38,901
1871	36,847
1872	45,974
1873	47,789
1874	53,532
1875	51,303
1876	49,011
1877	48,207
1878	49,102
1879	57,776
1880	54,170
1881	56,572
1882	61,489
1883	68 868
1884	73,797
1885	66,117
1886	58,427
1887	54,306
1888	65,521
1889	66,081
1890	81,372
1891	90,587
1892	84,069
1893	78,508
1894	73,927
1895	71,379
1896	82,769
1897	82,037
1898	83,118
1899	85,431
1900	90,105
1901	90,625
1902	92,917
1903	84,538
1904	90,402
1905	80,531
1906	82,536
1907	82,808
1908	82,126
1909	70,999
1910	75,031
1911	74,271
1912	82,069
1913	87,903
1914	77,403
1915	102,413
1916	100,090
1917	86 328
1918	37,621
1919	89,021
1920	60,475

Turpentine Tanks at London, England.

LONDON AS A TURPENTINE MARKET

(By Edwin Dodd, of Fairclough, Dodd & Jones, Naval Stores Dealers, London, England.)

[Mr. Edwin Dodd, senior member of the firm of Fairclough, Dodd & Jones, of London, is one of the best known and most highly esteemed members of the naval stores trade of the United Kingdom. He has been for many years connected in a large way with the trade in the British metropolis. During the World War Mr. Dodd served as Chairman of the United Kingdom Turpentine Association and rendered highly valuable service in that capacity. In May, 1920, the Association members presented him with a magnificent piece of old English silver plate as evidence of their appreciation of his labors.]

LONDON is undoubtedly the market to which more attention is paid and in which more interest is taken than any other. Here are focused so many interests, world-wide in extent, and here the speculator finds it most convenient to operate. The methods of purchase and sale, and settlement of differences make such transactions comparatively simple. Apart from the large consuming trade of London, and its purchases for spot and forward delivery, there is this outside speculation, and considerable arbitrage business, which adds materially to the quantity of turpentine changing hands from day to day, thus making London a more ready market upon which dealings may be carried out. If a buyer on the continent or at the outports of Great Britain makes purchase of turpentine for shipment, he might probably sell against this on the London market as a hedge against such purchase, and later on, as time of delivery drew near, he could cover back his London sale, and dispose of his original purchase to the port of shipment. By these means he is covered against market fluctuations, and this arbitrage is resorted to, to no small extent, and in this manner London serves a useful purpose.

The business for London itself is conducted on delivered terms. The turpentine is imported by several merchants, steamers arrive on the river Thames, the turpentine is taken by lighter (and that ex-tank steamers is pumped into tank barges) and landed at a public wharf, weighed gross and tared on landing. The barrels are piled up after the turpentine itself is shot into large tanks which are principally underground. Warrants are issued against these quantities for the net amount of the turpentine, and when delivery takes place the exact quantity is delivered to the buyer, the wharf assuming whatever loss in weight there may be in consideration of the rent of six pence (twelve cents) per ton per week which is chargeable. The landing charge is 15 shillings per ton, which includes delivery.

An illustration given herewith shows two overground tanks, of 3,500 tons and 4,000 tons capacity, surrounded by rosin and oil in barrels. In the distance on the right, are twelve 500-ton and six 400-ton tanks in which turpentine is stored. The principal stock of turpentine is held at Palmer's wharf, where there are sixty-five cisterns underground, with a total capacity of sixty thousand barrels.

The principal sales are made upon the Baltic Mercantile and Shipping Exchange, the Baltic Coffee House of ancient times, which traces its history back to 1744 when merchants interested in Russian tallow and grain carried on their business in one of the numerous Coffee Houses in the neighborhood of Lombard street. Another old Coffee House was the "Jerusalem," where Levant shippers met and out of which grew the Shipping Exchange. About fifteen years ago these two interests combined, and occupy the present building, which may be considered one of the finest produce exchanges of the world. The interior is built of marble of various hues all harmoniously blended The cost of building and offices was about two million dollars. The "Baltic" is an Exchange to which members subscribe, and is open all day.

The quantities dealt in range from single barrels to many hundreds of barrels, but in forward sale twenty-five barrels per month is considered the minimum, unless otherwise stated. Business is done for delivery extending to six or twelve months in advance and future purchases or sales made by consumers and dealers, and frequently by men of means (and otherwise) who know little about the article, except that fluctuations afford a means of speculation.

The telephone plays a large part in communication between the City dealers and the consumers in the outlying parts. Competition is about as keen

(Continued on page 272.)

Interior of "The Baltic," London, England, Where the "Turpentine Ring" Transacts Its Business.

HIGHEST AND LOWEST PRICES OF SPIRITS TURPENTINE PER CWT. (16 GALLONS OF 7 LBS.) AT LONDON, ENGLAND, IN SHILLINGS AND PENCE.

	January		February		March		April		May		June	
	H	L	H	L	H	L	H	L	H	L	H	L
1920	193/—	156/6	210/—	200/6	246/6	217/6	210/—	191/—	210/—	185/—	170/—	145/—
1919	105/—	105/—	100/—	100/—	95/—	95/—	99/—	95/—	105/—	99/—	105/—	87/6
1918	128/9	122/6	124/9	124/—	124/3	124/—	124/3	124/—	120/—	118/—	118/—	116/—
1917	55/—	52/—	56/9	52/—	54/9	51/6	54/9	52/6	55/3	52/6	55/—	54/—
1916	57/3	48/9	50/6	46/3	51/6	46/3	51/—	44/6	44/—	41/3	42/6	38/6
1915	38/9	35/9	43/—	38/—	43/—	36/6	37/7½	36/3	37/—	33/6	39/—	33/6
1914	33/—	32/1½	32/4½	31/9	32/6	32/—	32/3	31/1½	33/9	30/10½	34/3	32/6
1913	32/3	31/3	32/6	31/6	31/4½	27/—	29/6	28/3	29/6	28/4½	28/4½	27/6
1912	37/6	33/6	35/9	33/6	35/9	34/3	36/10½	33/9	37/—	34/6	35/10½	34/3
1911	57/9	56/—	63/6	57/9	74/3	63/3	71/—	62/—	64/—	46/—	48/—	43/—
1910	43/3	40/6	42/9	41/—	42/9	41/6	44/3	42/—	44/9	42/9	44/9	42/1
1909	30/9	28/9	30/—	27/3	27/—	26/—	28/—	25/6	29/3	26/6	32/9	28/—
1908	40/—	32/—	38/6	36/3	40/3	35/9	37/6	33/6	33/9	31/9	33/—	29/—
1907	51/9	50/3	51/9	51/—	51/9	50/6	52/—	51/3	52/3	50/3	48/—	42/3
1906	48/—	47/3	48/—	47/3	47/6	47/—	47/6	46/4½	49/—	48/3	48/—	45/6
1905	38/7½	37/9	37/3	36/9	42/6	38/—	45/—	43/3	60/6	44/9	63/6	45/6
1904	46/6	44/—	46/4½	44/—	42/6	41/9	42/9	41/6	42/—	41/6	41/4½	41/—
1903	42/6	40/9	43/9	42/9	44/3	43/—	43/6	42/9	42/9	39/4½	38/6	36/9

	July		August		September		October		November		December		For Year	
	H	L	H	L	H	L	H	L	H	L	H	L	H	L
1920	190/—	140/—	158/—	142/—	146/—	141/—	142/3	121/—	122/—	110/—	100/—	100/—	246/6	100/—
1919	123/—	86/—	130/—	121/3	130/6	125/6	127/6	119/9	128/—	125/6	156/6	126/6	156/6	86/—
1918	116/—	116/—	120/—	116/—	120/—	105/—	105/—	105/—	105/—	104/—	105/—	105/—	128/9	104/—
1917	56/3	55/—	58/—	55/9	67/—	58/—	89/6	68/6	113/—	90/—	128/—	113/—	128/—	51/6
1916	42/—	38/6	42/10½	41/3	43/9	42/—	44/9	42/9	49/4½	44/3	55/3	48/6	57/3	38/6
1915	40/6	34/—	34/9	33/9	35/10½	33/9	41/3	34/3	44/9	39/9	54/—	44/9	54/—	33/6
1914	34/4½	33/4½	38/6	33/6	34/—	29/6	32/6	30/3	36/—	31/3	36/3	33/3	38/6	29/6
1913	28/3	27/4½	30/4½	27/3	30/6	29/6	31/10½	29/9	32/7½	31/6	32/6	31/9	32/7½	27/—
1912	34/3	33/—	33/3	30/3	31/3	30/3	31/6	29/9	30/6	27/—	31/9	27/7½	37/6	27/—
1911	39/—	37/6	39/9	36/6	39/4½	38/—	38/3	35/—	35/9	33/9	37/6	35/9	74/3	33/9
1910	50/6	45/—	51/6	48/9	54/6	51/3	56/—	53/3	55/9	54/—	56/—	53/3	56/—	40/6
1909	36/—	33/9	41/—	36/—	43/3	39/9	42/9	40/6	41/—	39/9	40/9	38/6	43/3	25/6
1908	31/3	28/6	29/3	27/—	27/3	26/3	28/9	25/9	29/3	28/—	29/6	28/9	40/3	25/9
1907	42/—	41/6	41/9	40/9	40/3	38/3	38/9	38/—	37/—	35/3	35/3	32/—	52/3	32/—
1906	44/6	43/3	46/6	43/9	47/—	45/10½	49/3	48/3	49/6	48/6	50/3	49/—	50/3	43/3
1905	45/—	43/6	45/9	44/6	48/4½	46/—	51/—	49/3	51/3	44/6	48/6	45/9	63/6	36/9
1904	41/9	40/9	41/3	40/6	39/10½	38/9	39/3	38/6	38/7½	37/3	38/3	36/9	46/6	36/9
1903	39/3	38/—	42/6	39/3	44/—	42/—	43/7½	42/9	44/6	43/3	44/—	43/6½	44/6	36/9

as could be imagined. A buyer of five barrels a week has possibly half a dozen telephone messages a day, and needless to say they are not slow to play off one against another.

The business for forward delivery is done on the basis of twenty-five barrels, representing eighty hundredweight, and any excess or deficiency is settled at market price on the date of tender by seller to buyer, the seller having the option to tender at any time during each specified month. The buyer then applies for a Delivery Order or Warrant on the wharf, and generally is required to pay cash thereagainst.

It would be very difficult to give the number of trades in which turpentine is used. Naturally, the principal are paint, varnish and boot polish, but quite a quantity is used in other operations than these, too numerous to mention.

Substitutes, good, bad and indifferent, abound, their sales amounting to hundreds of barrels daily.

As regards handling rosin, there is but little to write. It is simply taken ex ship by large consumers direct to their own works, and the is conducted by the dealers ers ex wharf. The rosin is ed, sampled, weighed on l on landing weights, tare on out discount, payments days, but there is not suffici or speculation about it to w cle upon.

Rosin perhaps enters mo cret processes as an adulter stitute than many articles. clientele is more jealously g valued and buyers also ma to disclose their operations.

AVERAGE PRICE OF AMERICAN TURPENTINE FOR EACH YEAR FROM 1900 TO 1920 IN SHI AND PENCE PER CWT. OF 16 GALLONS.

1900	35s 4d	1905	45s 7d	1910	47s 8d	1915	
1901	27s 1d	1906	47s 3d	1911	47s 9d	1916	
1902	33s 1d	1907	44s 3d	1912	33s 1d	1917	
1903	42s 2d	1908	31s 9d	1913	30s 1d	1918	1
1904	41s 2d	1909	33s11d	1914	33s	1919	1
Average	35s 9d	Average	40s 7d	Average	38s 4d	Average	

The average price for 1920 was approximately 170s.

IMPORTS OF TURPENTINE INTO THE UNITED KINGDOM FROM ALL SOURCES IN TONS OF 2,240 (320 GALLONS OF 7 LBS.) OR 1,016 KILOS.

FROM	1870	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919
U. S.	3,027	21,245	19 960	19,593	25,184	18,298	18,264	18,181	28,757	23,820	14,725	20,902	18,429	10,132	1,011	19,057
France	....	....	1,535	989	1,201	1,020	1,138	1,183	899	1,683	975	2,025	261	9	1,214	1,784
Spain and Portugal	....	....	....	....	327	69	339	260	313	295	271	3,337	2,849	919	914	1,339
All Other Countries	*1,432	*5,089	4,147	4,933	1,882	2,782	3,871	4,382	2,842	2,219	1,439	211	....	....	....	562
TOTAL	4,459	26,334	25 642	25,515	28,684	22,169	23,612	24,006	32,811	28,017	17,410	26,475	21,539	11,060	3,166	22,742

*Includes imports from France, Spain and Portugal.

IMPORTS OF SPIRITS TURPENTINE FROM ALL COUNTRIES INTO THE UNITED KINGDOM, AND AVERAGE PRICE FOR EACH YEAR.

Year.	Tons of 2,240 lbs. (320 gals. of 7 lbs.)	Avg. Price per cwt. of 16 gals.
1870	4,459	....
1871	8,900	35s 8d
1872	11,000	42s 9d
1873	11,700	37s 7d
1874	13,700	28s 6d
1875	14 600	24s 7d
1876	11,800	24s10d
1877	12,800	26s10d
1878	16,200	23s 2d
1879	12,800	23s 5d
1880	13,500	32s 3d
1881	14,200	35s11d
1882	17,900	39s11d
1883	17,500	32s
1884	23,100	24s 3d
1885	15,400	25s 3d
1886	14,700	27s 1d
1887	17,900	27s 3d
1888	17,900	30s 1d
1889	20,400	34s 3d
1890	21,200	30s 6d
1891	21,100	28s 3d
1892	25 800	23s 5d
1893	22,600	22s 4d
1894	20,300	21s 4d
1895	25,100	21s 2d
1896	24,940	20s 1d
1897	25,140	21s 6d
1898	28,650	24s 6d
1899	24,790	34s 1d
1900	29,775	35s 4d
1901	32,190	27s 1d
1902	26,620	33s 1d
1903	26,655	42s 2d
1904	26,405	41s 2d
1905	26,333	45s 7d
1906	25,642	47s 3d
1907	25,515	44s 3d
1908	28,684	31
1909	22,169	33
1910	23,612	47
1911	24,006	47s
1912	32,811	33s
1913	28,017	30s
1914	17,410	33s
1915	26,475	38s
1916	21,539	45s
1917	11,060	66s
1918	3,166	116s
1919	22,791	111s
1920	22,559	App. 170

STOCKS SPIRITS TURPENTINE AT AND AFLOAT FOR LONDON DECEMBER 31, IN BARRELS (50 GALLONS.)

Year.	American.	French.	Spanish.	Afloat.	Total
1906	18,467	2,544	....	800	21,81
1907	24,614	1,051	....	7,750	33,41
1908	45,912	4.601	636	600	51,74
1909	26,735	3,680	299	3,500	34,21
1910	20,488	2,559	956	2,100	26,10
1911	24,686	1,569	276	14,188	40,71
1912	47,300	2,028	377	5,050	54,75
1913	56,253	4,224	340	4,000	64,85
1914	22,148	1,378	374	....	23,8
1915	32,952	1,341	7,486	....	41,77
1916	36,785	521	7,689	....	44,9
1917	17,774	67	2,053	....	19,8
1918	2,596	2,213	546	....	5,35
1919	29,776	454	260	....	30,49
1920	37,344	4,108	391	†	41,8

†Not given.

ROTTERDAM AS A NAVAL STORES PORT

(By Van Duura & Versteeven, Rotterdam, Holland.)

OWING to the lack of Government or other statistics there are no figures obtainable and so it is quite impossible for us to supply the figures of consumption of rosins and turpentine in our country. The only thing we can do is to give a statement of the receipts and sales of turpentine here, which we can gather from weekly reports of brokers here and only as far as turpentine is concerned, no such reports existing for rosins Of course, the figures during the war years are of no use whatever, receipts having come to a complete standstill owing to the submarine activities. Nor will the figures for 1919 serve as a guide, that year being still very abnormal because shipping was only resumed in the summer of that year. So only figures of some pre-war years may be of value.

For the years 1911, 1912 and 1913 we have compiled the following figures from the above named reports:

Barrels Turps.	1911	1912	1913
Stock Jan. 1	2,127	3,516	7,394
Receipts from America	46,477	75,568	96,318
	48,604	79,084	103,712
Sales (exports to Germany & Belgium included)	45,088	71,690	92,234
Stock Dec. 31	3,516	7,394	11,478

For the year April 1, 1919, to April 1, 1920, we find the following figures:

	Bbls Turps.
Stock April 1, 1919	128
Receipts from America	16,222
	16,350
Sales	14,714
Stock April 1, 1920	1,636

We cannot give any figures concerning rosins, nor of French or Spanish turpentine and rosins, which are also imported here, though the bulk is supplied from America.

For the reason named in the beginning we cannot possibly tell you how much of the turpentine given as sold has been reshipped to other countries.

Both commodities are used for different manufactures. Most of them have passed difficult years on account of the war, whereas others have much prospered owing to the extraordinary high prices to be obtained for their products. After the end of hostilities business in general has resumed in all branches, and as far as we can see the prospects of the industries using rosins and turpentine are tolerably well.

A United States consular report from Rotterdam gave the following turpentine figures for the war period:

Barrels.	1915	1916	1917
Supplies, Jan. 1	293	3,464	894
Imports for year	14,193	10,065	4,020
Deliveries for year	11,022	12 635	4,839
Supplies Dec. 31	3,464	894	75

NAVAL STORES TRADE OF THE NETHERLANDS

(From the Government Bureau of Statistics.)

***Imports of Rosins in Kilograms.**

Year.	From U. S.	All Other Countries.	Totals.
1905	29,883,712	15,458,260	45 341,972
1906	30,523,663	14,000,039	44,523,702
1907	35,499,681	14,975,495	50,475,176
1908	40 268,258	12,953,911	53,222,169
1909	22,735,133	18,821,639	41,556,772
1910	22,487,313	23,204,209	45,691,522
1911	28,531,985	27,552,746	56 084,731
1912	27,068,832	28,368,330	55,437,162
1913	27,617,694	24,561,490	52,179,184
1914	28 807,721	16,069,670	44,877,391
1915	5,179,193	10,868,323	16,047,519
1916	....	....	....
1917	336,430	372,419	708,849
1918	....	94,120	94,120

*Includes some quantities which were afterwards exported.

***Imports of Spirits Turpentine in Kilograms.**

Year.	From U. S.	All Other Countries.	Totals.
1905	6,172,746	1,169,099	7,341 845
1906	7,512,090	1,344,274	8.856.364
1907	8,858,492	1,056,764	9,915 256
1908	12,472,353	370,194	12,842.547
1909	8,486,720	402,531	8,889,251
1910	7,536 650	768,643	8,305,293
1911	9,144,298	1,867,769	11,012,067
1912	15,274,041	778,572	16,052,613
1913	18,918,608	695,704	19,614 312
1914	9,623,131	2,092,727	11,715,858
1915	1,710,720	1,975,192	3,685,912
1916	....	....	....
1917	459 310	670,458	1,129,768
1918	....	70,008	70,008

*Imports for consumption only. Kilogram equals 2.2046 lbs. avoirdupois.

Exports of Rosin in Kilograms.

(The bulk of the rosin and turpentine imported through the Netherlands passes into Germany and other countries for actual consumption.)

Year.	To Germany	To Other Countries.	Totals.
1905	34,850,476	1,389,538	36,240,014
1906	40,877,996	3,307,621	44,185,617
1907	38,549,596	5 620,008	44,169,604
1908	39,203,924	8,665,315	47,869,239
1909	32,623,108	5,985,343	38,608,451
1910	35,923,675	5 792,473	41,716,148
1911	42,314,289	6,328,053	48,642,342
1912	37,809,771	7,076.250	44,886,021
1913	35,793,185	7 686,225	43,479,410
1914	27,851,729	8,218,963	36,071,692
1915	6,783.838	2,563,263	9,347,101
1916	No statistics available		
1917	No statistics available		323
1918	No statistics available		10

Exports of Turpentine in Kilograms.

1905	2,543,149	633.603	3,176,752
1906	3,774,410	799,908	4,574,318
1907	4,518,129	954.769	5,472,898
1908	4,743,735	1.304,443	6 048,178
1909	4,864,373	918,957	5,783,330
1910	4,893,769	713,753	5,607,522
1911	5,983,264	1 163,190	7,146,454
1912	9,618,976	1,452,038	11,071.014
1913	11,548,051	1,656,589	13 206,640
1914	8,095.195	927 251	9,022,446
1915	65,725	35,587	101,312
1916	No statistics available		
1917	No statistics available		6,633
1918	No statistics available		88

GREEK NAVAL STORES IMPORTS AND EXPORTS

(For additional statistics see page 192.)

Greek imports and exports of naval stores for the year 1919 and the first nine months, January-September, of 1920, were as follows:

Imports in Kilos (1,015 to Ton)

	Rosin.	Turpentine.
Year 1919	143,661	93.520
9 mos. 1920	17.099	112

Exports in Kilos.

	Rosin.	Turpentine.
Year 1919	2,716,513	499,776
9 mos. 1920	4,096,676	804,170

ANTWERP AS A NAVAL STORES PORT

(By H. Speth, of European Naval Stores Co., Antwerp.)

WHEN in August, 1914, the war broke out, business was stopped altogether; the uncertainty as to the fate of Antwerp, the stronghold of Belgium, imposed on all concerned the greatest caution.

Fortunately, we hasten to say, the plants and tanks have not suffered, but the landing pier was partly destroyed by a fire caused by the bombardment.

At the fall of Antwerp, in October, 1914, the stocks of naval stores were rather limited, viz:

3,000 barrels spirits of turpentine.
10,000 barrels rosin.

These stocks, as well as those of all other commodities, were requisitioned by the Germans, and as imports were entirely stopped, a complete standstill resulted, which lasted until well in 1919.

Business has been slowly resumed since. The lack of raw material, however, prevented most factories from starting working again.

Besides, the financial position seriously handicapped most industries, but the situation has since considerably improved and prospects for a further revival of business as a whole are most encouraging.

The first supplies of naval stores came from France and Spain, whereas, owing to difficulty of transportation, the American products did not arrive before the spring of 1919.

The imports of naval stores in 1919 and 1920 have been rather limited compared to the pre-war imports.

Owing to the high prices, consumption has seriously decreased, especially in turpentine, most of the consuming manufacturers using substitutes.

In consequence of the financial position in Germany and Austria we cannot now rely on these countries for an important outlet, the depreciation of their currency almost entirely preventing trading with that territory.

The same condition applies to Hamburg, which place, still more than Antwerp, suffers severely from the present state of things

---

In 1912 Mr Speth described conditions prior to the war as follows:

In Antwerp there are no public warehouses for naval stores. We use for the warehousing of our stocks the plants of the Societe Anonyme d'Entreposage & de Transports. The Spanish Union Resinera also owns a small warehouse without any tankage. Owing to the difficulty in warehousing there is practically no speculative nor spot trading done on Exchange floor in Antwerp.

In Hamburg there is a public warehouse for naval stores, but without tanks New private and public warehouses will be erected in a short while in Hamburg, so that pictures of the old sheds now used can hardly be of interest.

There is a certain amount of business, as well spot as speculative, done on the Hamburg Exchange, but these transactions are of minor importance compared to the total import of naval stores in Hamburg.

In Rotterdam the situation is about the same as in Hamburg, but public warehouses have tankage facilities.

Antwerp supplies the entire Belgium territory and competes with Rotterdam for the business on the Rhine, South Germany and in Switzerland, while

IMPORTS OF NAVAL STORES INTO BELGIUM FROM VARIOUS COUNTRIES.

(From the Department of Statistics, Brussels)

KILOS OF TURPENTINE From	1911	1912	1913	(6 months) 1914	1919
Germany	65,028	39,340	30,902	5,150	7,000
Spain	1,750,720	1,478,200	1,986,925	1,048,700	1,389,893
United States	8,030,854	5,744,286	4,576,970	1,220,450	741,836
France	384,339	199,834	170,471	32,314	282,048
Great Britain	298,566	562,355	479,436	148,326	1,094,690
Holland	934,701	1,412,952	1,575,332	325,802	5,618
Portugal	322,400	513,900	893,400	....	31,190
All others	9,334	22,054	63,361	*508,952	2,447
Totals	11,795,942	9,972,921	9,776,797	3,289,694	3,554,722

* Including Portugal.

KILOS OF ROSIN From	1911	1912	1913	(6 months) 1914	1919
Belgian Congo	1,717,163	3,615,693	4,501,227	3,072,983	864,388
Germany	863,420	773,510	1,488,810	975,190	2,000
Spain	3,935,908	6,140,116	5,234,328	2,056,952	3,418,196
United States	20,268,177	10,307,025	14,282,708	4,732,100	1,491,422
France	7,050,140	7,745,177	6,232,122	3,647,960	4,134,637
Great Britain	445,177	1,779,432	1,575,977	236,710	2,765,000
Holland	890,312	940,266	2,001,769	650,654	714,033
Portugal	321,618	1,124,943	804,688	....	72,415
Russia	292,176	176,934	146,525	....	....
Sweden	27,635	318,329	704,288	....	974,151
All others	218,534	615,319	415,947	*1,086,781	127,201
Totals	36,030,260	33,536,744	37,388,389	16,459,330	14,563,443

* Including Portugal, Russia and Sweden.

Hamburg supplies the rest of Germany and Austria (except a small proportion supplied from Trieste.)

Antwerp and Hamburg both export to Norway and Sweden. France and Spain export, however, quite important quantities direct to consumers of Germany, Austria and Switzerland.

(By Gustave Levita, of Levita & Co., Antwerp.)

THE tank accommodations as well as usual wharves for rosin and turpentine did not suffer during the war, and in consequence Antwerp will be able to store turpentine and rosin just the same as before hostilities.

Before the war, we had in Belgium ten to twelve large varnish manufacturers, but owing to the difficulties in purchasing raw material only very few of them, if any, had been able to manufacture varnishes by the summer of 1920, and in consequence the U. K. was supplying Belgian consumption.

This does not make any difference with regard to the quantities of turpentine and rosin consumed because the turpentine and rosin, instead of coming to Antwerp, was shipped to the United Kingdom, where it was manufactured and shipped to Belgium.

This position is only transitory till our varnish makers are able to purchase all the raw material they require.

We think that the polish manufacturers have done very well since the armistice because before the war a large quantity of polish used in Belgium was supplied by Germany.

It is generally expected that it will be well into 1921 before the trade in Belgium will be restored and we may add that we believe that owing to the activity of the Belgians, they will increase considerably their manufactured production, taking the position which was held by the Germans

As all are aware, Antwerp is importing large quantities of rosin and turpentine from France and Spain which is cheaper than American, and therefore it appears on your side that Belgium has not yet started their transactions as large as before the war.

PRODUCERS' NET PROCEEDS FOR THE SEASON OF 1919-'20

REFERRING to the table of net proceeds to producers for rosins and turpentine, on page 98, Mr. Carson's records for the season of 1919-'20, ending November 30, give the following figures of the actual cash returns to producers whose naval stores were handled by his house:

Spts. Turp. Per Bbl.	Rosin Per Bbl.	Per Unit of One Bbl. Turpentine and 3 1/3 Bbls. of Rosin.
$70.25	$23.12	$147.31

SWEDEN'S IMPORTS AND EXPORTS OF ROSIN AND TURPENTINE OIL (SPIRITS).

(From the Bureau of Statistics, Stockholm.)

IMPORTS OF ROSIN IN KILOGRAMS

Year.	From United States.	From France.	From *Germany.	From Other Countries.	Totals.
1909	524,310	381,552	2,777,209	353,693	4,036,764
1910	765,766	519,225	3,549,273	292,452	5,126,716
1911	345,623	366,233	4,636,586	368,157	5,716,599
1912	587,103	335,212	5,095,990	312,999	6,331,304
1913	249,456	281,873	6,109,672	436,987	7,077,988
1914	1,220,851	694,250	3,459,103	1,132,175	6,506,379
1915	2,174,913	782,671	127,565	3,643,509	6,728,658
1916	4,823,860	1,070,915	39,901	3,052,764	8,987,440
1917	5,809	3,016	61	88,567	97,453
1918	61	109,496	60	76,582	186,199

*Imports from Germany mainly American rosin re-shipped from Germany.

IMPORTS OF TURPENTINE OIL (SPIRITS) IN KILOGRAMS.

Year.	From United States.	From France.	From *Germany	From Other Countries.	Totals.
1909	....	228,851	120,354	63,241	412,446
1910	....	216,272	78,940	102,695	397,907
1911	477	264,851	57,550	104,719	427,597
1912	782	186,714	126,780	115,961	430,237
1913	....	267,723	127,509	120,417	515,649
1914	....	181,182	82,717	96,491	360,840
1915	37,639	187,575	2,105	132,667	359,986
1916	70,436	49,587	842	103,584	324,449
1917	469	....	1	12,448	12,918
1918	331	6	....	729	1,066

*Mainly. American re-shipped.

EXPORTS IN KILOGRAMS.

Year.	Rosin.	Turpentine Oil (Spirits)	Year.	Rosin.	Turpentine Oil (Spirits)
1909	118,691	43,350	1914	814,353	523,239
1910	373,556	167,192	1915	939,496	664,717
1911	480,153	306,449	1916	3,137,019	469,203
1912	61,560	262,282	1917	1,390,434	381,160
1913	8,694	228,261	1918	687,571	31,375

IMPORTS OF NAVAL STORES INTO DENMARK.

(From the Department of Statistics, Copenhagen.)

Year.	Rosin (Fyrreharpiks) Total imports in 100 kgs.	Rosin (Fyrreharpiks) Imports from U. S. A. in 100 kgs.	Turpentine (Terpentin) Total imports in 100 kgs.	Turpentine (Terpentin) Imports from U. S. A. in 100 kgs.	Oil of turpentine (Terpentinolie) Total imports in 100 kgs.	Oil of turpentine (Terpentinolie) Imports from U. S. A. in 100 kgs.
1910	13,400	2,534	84	......	4,543	....
1911	13,940	10	75	......	4,492	....
1912	14,680	148	119	......	4,953	....
1913	15,478	480	154	......	5,124	....
1914	13,886	3,906	130	......	4,748	36
1915	22,533	4,495	46	......	4,760	32
1916	20,824	6,359	71	......	5,226	....
1917	6,706	2,643	44	......	1,679	....
1918	3,298	996	17	15	1,241	....
1919	30,053	13,999	374	132	6,105	3,595

EXPORTS OF NAVAL STORES FROM FRANCE AND VALUES, 1905-1920

(Supplied by Ad. Genvrain & Co., 11 Rue du Bouloi, Paris, France.)

Year.	Rosin In Tons of 2,240 lbs.	Value In Francs.
1905	59,384	15,071,631
1906	37,888	8,547,000
1907	37,961	8,564,064
1908	49,268	10.643,756
1909	57,455	13,502,050
1910	55 945	16,828,288
1911	58,931	17,726,432
1912	70,528	21,214,944
1913	43,642	11,486,664
1914	46,143	11,277,396
1915	53,826	24,286,656
1916	32 557	14,690,016
1917	27,262	16,657,290
1918	17,620	13,250,720
1919	51,786	73,019,100
1920	61,957	82,509,000

Year.	Spirits Turpentine In Tons of 2,240 lbs.	Value In Francs.
1905	12,215	12,459 036
1906	12,938	11,657,225
1907	9,754	7.876,545
1908	9,856	4.915,326
1909	11,056	6,867,901
1910	12,672	12 462,770
1911	12,428	9,807,570
1912	9,924	6.548.175
1913	14,044	8,625,050
1914	6,544	4,005,504
1915	4,786	4,678 890
1916	3,236	3,164,110
1917	1.463	1.990.240
1918	2,807	4.175.850
1919	6,780	20,169,800
1920	11,948	35 488,000

All weights are gross. For net, seven per cent tare.

Of the exports of rosins, those to the main consuming countries were as follows, in tons of 2,240 lbs.:

Year.	Great Britain.	Germany.	Belgium.
1905	22,035	9,735	7,699
1906	10 766	7,667	5.650
1907	11,440	5,805	5,015
1908	18,814	8,574	4,591
1909	19,080	12,028	6.994
1910	17,993	10,215	7.198
1911	14,345	12 605	8,130
1912	19,595	14,646	9,187
1913	9,591	9,563	6.848
1914	16,952	5,464	5.237
1915	40,215	....	....
1916	16,480	....	....
1917	14,991	....	....
1918	12 135	....	....
1919	22,712	5,267	6,224
1920	23,028	8,823	5,712

Year.	Russia.	Holland.	Italy.
1905	9,898	5,521	627
1906	5,435	4,248	538
1907	5,775	4,724	292
1908	5,932	3 782	499
1909	5,982	4,661	438
1910	6,369	5,998	838
1911	7,752	6,916	956
1912	4,846	9,006	1,481
1913	4,065	6,446	1,490
1914	5 057	4,196	1,277
1915	767	1,046	2,204
1916	3,221	812	2,873
1917	1,262	340	6.918
1918	....	....	4,643
1919	102	2,383	8,807
1920	5	4,576	7,861

Of the exports of spirits turpentine those to the main consuming countries were as follows, in tons of 2,240 lbs.:

Year.	Great Britain	Germany.	Belgium.
1905	1 857	4,107	2,035
1906	1,449	3,582	1,627
1907	1,561	2,441	1,389
1908	1.356	2,759	821
1909	1,281	3,930	280
1910	1,495	3,583	447
1911	1,447	3 983	435
1912	1.177	2.363	231
1913	2,086	4,222	186
1914	1,306	1,278	448
1915	2,376	....	....
1916	357	....	....
1917	....	....	....
1918	2.231	....	....
1919	3,941	299	398
1920	4,414	601	1,641

Year.	Switzerland.	Holland.	Italy.
1905	662	485	1,139
1906	740	546	1,102
1907	554	632	1,418
1908	1.213	195	1,754
1909	2,378	....	1,602
1910	3.202	....	1,444
1911	3,472	....	1,112
1912	2,943	....	1,453
1913	3,510	....	1,949
1914	1 200	122	1,248
1915	796	92	632
1916	1,116	....	694
1917	631	....	401
1918	10	....	363
1919	176	507	1,024
1920	1,135	1,709	1,161

HOW FRENCH SUPERFINE ROSINS ARE DESIGNATED

As is perhaps generally known, the French make grades of rosins much lighter in color than the highest American standard grade of waterwhite. These extra pale rosins are the subject of special transactions in trade. There is a class of double letters in their classification, and they are known as DD, CC, BB, AB, AA (2 A), AAA (3 A), AAAA (4 A), and AAAAA (5 A). The last designation of rosin, 5 A, represents at this time the maximum of perfection or purity in that commodity and there is a pronounced difference in its color and that of the American and French waterwhite.

PRODUCTS OF FRENCH DISTILLATION OF MARITIME PINE GUM

A government report on the French naval stores industry states that the resulting products of the distillation of the gum of the maritime pine are as follows:

Spirits of turpentine, 15 to 20 per cent.

Rosin, 65 to 75 per cent.

Diverse products, 5 to 10 per cent.

Residue and vapor make up the balance.

CENSUS BUREAU REPORT ON NAVAL STORES PRODUCTION IN 1919

The United States Census Bureau compiles its naval stores statistics every five years—and for the calendar year ending December 31 instead of the crop year closing March 31. Its report on production for 1919 was not issued until May, 1921. The U. S. Bureau of Chemistry's report on production for the crop year April 1, 1919, to March 31, 1920, was issued in the spring of 1920. It appears on page 81 The two reports are given below in comparison:

Spirits Turpentine (Bbls. of 50 Gals.)

State.	Bureau Chemistry.	Census Bureau.
Alabama	38,100	41 604
Florida	136,900	139.850
Georgia	73,900	79,946
Louisiana	68.700	87,704
Mississippi	29,500	34,996
N. Carolina	600	1,344
S. Carolina	1,100	1,168
Texas	17,200	18,128
Totals	366,000	354 740
Value	....	$20,710,400

Rosins, (Bbls. of 500 Lbs.)

State.	Bureau Chemistry.	Census Bureau.
Alabama	126,000	123,536
Florida	457,500	486,416
Georgia	250,600	234,696
Louisiana	232,000	112,896
Mississippi	102,800	115,976
N. Carolina	2,200	4,088
S. Carolina	3,400	3,528
Texas	62,500	60,200
Totals	1,237,000	1,141,336
Value	....	$81,952,400

The difference in the totals, Mr. F. P. Veitch, of the Bureau of Chemistry, points out, is due to the difference in the twelve months covered. The great discrepancy in the report for Louisiana arose from the fact, he points out, that producers operating in that State had operations in other States and combined them in their reports, the totals being credited to Louisiana

On pages 81 and 82 will be found statistics of production for a number of years.

COMMON AND SCIENTIFIC NAMES OF CHIEF NAVAL STORES PRODUCING TREES

Douglas fir—Pseudotsuga taxifolia; also mucronata.

Maritime pine—Pinus maritima.

Pine, Cuban or slash—Pinus heterophylla, also caribaea.

Pine, loblolly—Pinus taeda.

Pine, longleaf—Pinus palustris.

Pine, pitch—Pinus rigida.

Pine, shortleaf—Pinus echinata.

Pine, western yellow—Pinus ponderosa.

Scotch or wild fir—Pinus sylvestris.

The shortleaf and loblolly pines are sometimes referred to as North Carolina pines.

The longleaf, shortleaf, loblolly and Cuban pines are sometimes referred to as southern yellow pines.

HIGH AND LOW PRICES OF FRENCH TURPENTINE AT DAX, LANDES, FRANCE, IN FRANCS, PER 100 KILOS (220 Lbs.)

FROM DATA SUPPLIED BY AD. GENVRAIN & CO., PARIS

MONTH	1910		1911		1912		1913		1914		1915		1916		1917		1918		1919		1920	
	H	L	H	L	H	L	H	L	H	L	H	L	H	L	H	L	H	L	H	L	H	L
January	96	89	127	121	87	78	65	62	69	64	......	......	114	103	165	162	206	200	250	240	820	580
February	97	96	140	128	78	74	67	65	69	66	......	......	108	105	162	155	200	195	250	215	905	880
March	97	93	150	138	75	72	67	59	70	65	......	......	109	103	155	115	235	202	225	210	900	850
April	95	91	150	125	70	68	57	57	71	65	70	66	110	108	140	115	220	215	260	230	850	800
May	94	92	115	87	75	71	57	57	67	64	70	68	105	103	136	125	260	235	290	270	750	550
June	89	87	90	86	72	70	56	52	71	67	68	65	105	105	138	135	305	275	305	285	525	350
July	102	90	85	75	72	68	53	51	70	69	70	68	106	105	135	132	305	300	303	290	510	375
August	105	100	81	74	68	66	57	53	......	......	80	68	109	107	144	139	306	300	335	310	600	550
September	116	108	82	76	66	66	57	55	......	......	72	71	117	111	147	145	305	300	350	338	615	560
October	119	119	74	72	65	63	58	55	......	......	80	72	138	120	151	146	320	310	350	350	620	565
November	119	115	72	67	62	57	62	60	......	......	100	78	150	140	200	165	325	253	480	385	560	545
December	118	112	87	72	60	58	62	62	......	......	103	100	165	155	223	205	270	260	550	510	......	......
For Year	119	87	150	67	87	57	67	51	71	64	103	65	165	103	223	115	325	195	550	210	905	350

AVERAGE MONTHLY PRICE OF F-G ROSIN AT DAX, LANDES, FRANCE, IN FRANCS PER 100 KILOS (220 LBS.),

FROM DATA SUPPLIED BY AD. GENVRAIN & CO., PARIS.

1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920
23.—	32.—	35.—	36.50	22.—	14.—	43.50	53.50	70.75	78.—	191.—
24.—	33.—	34.—	37.—	21.50	....	43.—	54.—	69.50	80.—	226.—
24.—	35.—	36.—	36.—	21.—	16.25@50	43.50	58.—	66.50	....	253.75
24.—	34.—	35.75	29.75	21.50	17.25@18	44.50	60.—	....	60.—	273.75
24.—	34.—	35.75	27.25	20.50	17.50	42.—	61.50	69.75	66.50	234.—
23.—	35.—	37.—	26.75	21.25	18.—	43.50	67.25	75.50	75.50	152.50
26.—	35.—	37.—	24.25	20.—	19.—	43.75	69.—	75.—	94.25	137.50
27.—	34.—	37.25	24.—	....	22.—	45.50	71.25	74.50	108.—	188.75
28.—	35.—	38.—	22.—	....	24.—	47.50	74.—	76.25	122.50	201.25
28.—	34.—	38.25	21.25	....	26.50	48.50	73.25	80.25	129.—	188.25
28.—	33.—	37.—	21.50	....	37.50	49.50	72.—	80.75	156.—	168.25
29.—	34.—	36.—	21.—	....	43.—	51.—	73.25	78.—	183.75	....
25.65	34.—	36.40	27.25	21.—	23.20	45.45	65.60	74.25	104.86	201.35

PRODUCTION OF WOOD TURPENTINE AND OF WOOD ROSIN

The reports of the United States Census Bureau give the following figures of production of wood turpentine and of wood rosin:

	Wood Turpentine Bbls. 50 gals.	Wood Rosin Bbls. 500 lbs.
1919	31,686	124,178
1914	11,512	29,008

The number of plants reporting in 1919 was 22, in 1914 it was 14. The values reported for the products were as follows:

	1919.	1914.
Wood turpentine	$1,207,700	$194,200
Wood rosin	2,742,600	198,200

HIGHEST AND LOWEST PRICE OF SPIRITS TURPENTINE AT SAVANNAH, SEASON 1920-21

(High and Low Prices, 1880-1919, see page 83.)

Month	High	Low
April	$2.33	$1.82
May	1.95	1.72½
June	1.69	1.43
July	1.55	1.25
August	1.58½	1.37
September	1.40½	1.27½
October	1.23	1.00
November	1.23	.87
December	N. D.	N.D.
1921.		
January	N. D.	N. D.
February	.52	.50
March	.54½	.45
For year	$2.33	$ .45

PITCH AND TAR PRICES AT NEW YORK FOR YEAR 1920.

(For Pitch and Tar Prices for 1905-19, see page 278.)

Month.	Pitch. H	Pitch. L	Kiln Tar. H	Kiln Tar. L
January	$ 8.50	$ 8.50	$14.50	$14.50
February	8.50	8.50	15.50	15.00
March	8.50	8.50	15.00	14.50
April	8.50	8.50	14.50	14.50
May	8.50	8.50	14.50	14.50
June	15.00	14.50	14.50	14.50
July	14.50	14.00	14.75	14.50
August	14.50	14.00	15.00	14.75
September	14.00	12.00	15.00	15.00
October	12.00	10.50	15.00	14.75
November	10.50	10.50	14.75	14.75
December	10.00	9.50	15.00	14.50
Year	15.00	8.50	15.00	14.50

STOCKS OF TURPENTINE AT CLOSE OF SEASON, MARCH 31, IN BARRELS OF 50 GALLONS.

Year.	Savannah.	Jacksonville.	Pensacola.	Totals.
1921	4,946	18,244	5,648	28,838
1920	2,000	1,809	1,010	4,819
1919	18,850	43,860	34,740	97,450
1918	24,095	59,889	41,839	125,823
1917	11,169	29,511	24,346	65,026
1916	7,620	22,944	18,718	49,282
1915	22,510	15,598	***	38,108

***Stocks not available.

STOCKS OF ROSINS AT CLOSE OF SEASON, MARCH 31, IN ROUND BARRELS (500 LBS.)

Year.	Savannah.	Jacksonville.	Pensacola.	Totals.
1921	85,029	175,833	58,485	319,347
1920	18,631	48,346	36,576	103,553
1919	62,547	131,435	49,831	243,813
1918	94,310	177,987	73,250	345,547
1917	103,456	157,106	92,945	353,507
1916	72,832	148,294	101,918	323,044
1915	105,333	97,856	***	203,189

***Stocks not available.

IMPORTS OF NAVAL STORES INTO ITALY.

(From the Central Office of Statistics, Rome, Italy.)

Imports Spirits Turpentine (Di "Trementina")

(In Quintali of 100 Kilos, or 220 Lbs.)

From	1912	1913	1914	1915	1916	1917	1918	1919
Greece	2,364	2,312	8,255	7,960	6,716	731	....	1,369
France	19,776	24,821	16,870	7,465	7,561	4,733	4,515	12,176
Spain	....	....	345	8,282	9,625	10,335	6,788	4,549
United States	9,139	7,233	2,247	7,887	727	6,852	7,604	20,114
All Others	1,166	289	831	9	....	288	3,115	930
Total	32,445	34,655	28,548	31,603	24,629	22,939	21,967	39,138

Imports of Rosin ("Colofonia.") (In Quintali of 100 Kilos, or 220 Lbs.)

From	1912	1913	1914	1915	1916	1917	1918	1919
Greece	22 645	11,282	12,759	21,272	46,371	38,391	31,500	18,574
France	13,156	12,308	14,125	22,076	27,736	76,970	40,539	98,019
Spain	138	250	1,128	26,265	17,625	37,744	30,787	12,226
U. States	131,417	153,820	116,635	176,453	107,130	52,696	2,518	29,938
All Others	3,054	3,407	4,924	1,330	336	506	191	2,068
Totals	170 410	181,067	149,571	247,396	199,198	206,307	105,535	160,825

OFFICIAL ANNUAL REPORT NAVAL STORES INSPECTED IN FLORIDA, FOR THE CROP YEAR ENDING MARCH 31st, 1921-1917

(With Comparisons Given in Barrels By Grades.)

(Prepared by D. C. Campbell, Supervising Inspector of Naval Stores for the State of Florida, Jacksonville, Fla.)

	—AT—			Totals by	Totals Year Ending Mar. 31			
Grades.	Jacksonville.	Pensacola.	Interior.	Grades, 1921.	1920.	1919.	1918.	1917
B	10,009	8,381	1,815	20,205	27,773	19,122	27,958	37,644
D	13,175	11,241	1,345	25,761	21,720	20,134	20,586	24,772
E	16,972	37,344	2,456	56,772	76,330	59,298	82,187	64,105
F	38,374	20,639	4,243	63,256	65 319	55,221	73,264	116,232
G	40,893	25,491	7,871	74,255	88,152	87,879	122,569	169,306
H	51,146	31 924	10,662	93,732	96,746	84,686	144,571	155,032
I	42,001	17,842	7,307	67,150	68,490	52,795	112,135	109,126
K	36,195	8,488	7,579	52,262	44,847	36,472	82,349	84,553
M	29,003	6,298	5,855	41,156	31,246	24,734	61,273	67,111
N	21,584	4,306	4,759	30,649	19,405	16,959	40,675	39,083
W G	18,017	2,261	3,993	24,271	13,998	12,106	27,971	32,179
W W	18 942	1,994	6,080	27,016	17,678	13,601	31,952	38,310
X	3,188	384	....	3,572	5,254	2,925	6,623	3,590
O P	156	333	1	490	1,296	2,232	636	731
S D	37	51	....	88	193	20	104	153
Total	339,692	176,977	63,966	580,635	578,447	488,184	834,853	941,927

ILLUSTRATIONS

(Continued from Page 7)

INDEX

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